GAYLORD F

A R C H I T E C T U R A L   C O M P O S I T I O N

GENERAL PRINCIPLES

By Professor H. Wagner

PROPORTIONS IN ARCHITECTURE

By Professor A. Thiersch

DESIGN OF THE BUILDING

By Professor H. Wagner

TREAMMENT OF EXTERNAL AND INTERNAL ARCHITECTURE

By Professor J Bühlmann

ENTRANCES, STAIRS, COURTS, AND HALLS

By Professor H. Wagner

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PROBLEM AND AIM OF ARCHITECTURAL CREATION.

By Professor Wagner.

1. Primary Ideas.

Every building and work of human creation must serve a definite purpose. For fulfilling this purpose, that building is most suitable, to which an appearance and form are given, suited to the purpose of the building and pleasing to theeye. To understand these requirements more accurately, the primary ideas in Architecture must here be stated.

For the structure to fulfill its aim, it must first accord with the material conditions, which are subject to constant change, for development and refinement of civilization have modified the primitive and simplest requirements of life, continually producing new deeds and new problems in manifold variety. An infinite domain is opened to man's creative impulse; no problem is so minute as to be unworthy his mind, none too great for his grasp. However diverse the conditions, the laws for their treatment are invariable. We obey the eternal rule of nature, evident in its lowest and its highest organisms. For the work of man to completely fulfil its purpose, like the products of nature, each part must fulfil the function assigned to it and take the appropriate form. The entire structure must be a truthful expression of the ideas, that called it into existence.

If the work has an ideal meaning as a worthy monument of human creation and is to endure to future ages, then must it likewise suit the tendency of the human mind toward elevation and perfection, and must appear in graceful and beautiful form.

2. Nature of Architectural Creation.

This gives the requirements that clearly distinguish works in architecture from creations in other arts. Painters and sculptors execute while they conceive and require no assistance from others. Not so with the Architect. For the creative mind is in architecture more intimately connected with the material than in other arts: it is subject to the laws of science, must satisfy conditions of construction, and for the embodying its results, requires combined efforts of many men and expenditure of money not necessary in Painting and Sculpture, still less so in Poetry and Music.

In every branch of knowledge, the judgement chiefly executes the erection of the building by the art of construction. But if this is to become an architectural creation, knowledge of the true must be joined with perception of the beautiful, aided by imagination. It is not sufficient for the creative idea to be clearly and truthfully expressed; it must appear in judicious forms, pleasing to the eye, to be understood. It is not enough for each part to recieve the form best adapted to the requirement assign-

[illegible] taste and judgment [illegible] of the same time to [illegible] [illegible]. In [illegible], the [illegible], it is [illegible] to [illegible] the exterior of the building with artistic forms, according to the [illegible] style, and forms are less easily [illegible] and [illegible] so [illegible], as in the [illegible] of [illegible] before, to a [illegible] [illegible] from [illegible]. [illegible] [illegible] of the exterior and [illegible] of the [illegible] to [illegible] the [illegible], each [illegible] and [illegible] of the [illegible] that best suited to its purpose. [illegible] of the [illegible] [illegible] to be grouped and divided [illegible] [illegible] [illegible], just as [illegible] for [illegible] [illegible]. [illegible] and [illegible] are to be considered, and [illegible] and [illegible] of forms.

[illegible] the [illegible] of [illegible] [illegible] [illegible] proportion, [illegible] [illegible] and [illegible] of color. [illegible] the power of [illegible], [illegible] by [illegible], [illegible] the [illegible] of the [illegible] and to [illegible] for [illegible] [illegible] the [illegible] of [illegible] and [illegible], [illegible] [illegible] [illegible] of their [illegible] [illegible] [illegible], [illegible] the [illegible] [illegible] [illegible].

[illegible] [illegible] [illegible] by the [illegible] [illegible], and the [illegible] [illegible]. [illegible] [illegible] of [illegible] and [illegible], [illegible] [illegible] [illegible] from the [illegible] of the building. [illegible] [illegible] of [illegible] [illegible], [illegible] of [illegible], [illegible] [illegible].

3. [illegible] of [illegible].

The [illegible] [illegible] to [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] of the [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

ed to it in the entire organism; this form must at the same time be beautiful. In representing the beautiful, it is primarily essential to invest the exterior of the building with artistic forms, according to the law of the style; art forms are less easily understood and do not act on the feelings so directly, as in the modes of expression of other arts, since they belong to a language to be learned from nature. For most works in architecture, both the appearance of the exterior and that of the interior are to be designed and harmonized; each room and each part of the building must have that effect suited to its purpose. Parts of the structure enclosing space are to be so grouped and divided as to present on all sides a pleasing effect, just as required for works of Sculpture. Local and climatic conditions are to be considered, and affect plan, arrangement, and also treatment of forms.

These can only obtain the consecration of art by regularity in arrangement and harmony of proportions, attaining perfection by appropriate decoration and splendor of color. This requires the power of imagination, not confused by any difficulties, able to grasp the peculiarities of the problem and to deduce therefrom suggestions for characteristic expression. This requires the assistance of Painting and Sculpture, for which Architecture creates locations for effective treatment of their reproductions, in order to bring forth in combination with them the most perfect and most sublime works of the formative arts.

These indicate the paths to be followed by the creative thought in architecture, and the aim to be reached. For architectural composition or design is a condensation of science and knowledge, that experience, science and art required from the creator of the building. It manifests the triad of ideas summarized in fulfilment of purpose, truth of idea, and beauty of form.

3. Two-fold Problem of Architect.

The artistic side is therefore emphatic in designing a building, but is not the sole problem of the architect in architectural composition, his labors not ending with it. If a master of his art in the full sense, his creation only terminates with the completed structure, and to realize this, he must be both master of form and construction. He must be such in conceiving, and still more in completing the design, for the construction is the means of its realization. As constructor, he selects and employs the building materials according to their natural peculiarities and conditions; by the aid of science and experience, he chooses the method and system adapted to the materials; he dimensions parts of the structure in accordance with their loads, and arranges them to best suit their purpose.

Their formal treatment is then by the artist.

Prepared thus and clearly set forth in words and drawings, accurately dimensioned and estimated, the work is ready for execution.

A new series of labors of the architect begins when he is the creator of his work in the fuller sense. Execution and conception in architecture, as in every art are most intimately connected. The designer of the building must give it the stamp of his mind, even its smallest details, and as its overseer, must fill assistants, foremen and workmen with this spirit, to set stone on stone, join member to member, and create a work in which the law of harmony and the unity of design may fully appear. What was devised in an hour of inspiration, and was built up in his mind during long days of contest with external and internal requirements, demands months and years of continuous labor, the work of skillful hands under the architect's guidance, and he must aid the performance of their duties, must watch over them, and their claims and demands must be subject to his examination and control.

4. Problem of Builder.

With the beginning of the practical duties of the architect, the work enters a new phase, has passed under the superintendent of construction, and by his knowledge of business, of expedients in each branch of his calling, he is to aid the architect in his comprehensive and difficult problem. he supplies the best materials for the work, prepares this in workshops and at the building, combines it according to directions and rules, arranges the labor as most rational and preferable, and erects the building rapidly and in a masterly manner.

We enter here the domain of the superintendent of construction, not to diminish it, but to fix its limits and protect the creative realm of the architect from encroachment. Each has a broad and fruitful field; the trades to the superintendent and arts to the architect. Each should be content with his own and not encroach upon another. The limits of each domain are so extensive, that human life does not suffice to exhaust them. The entire energy and intelligence of the one are due to the increased requirements of his calling, and the entire talents of the other to truly solve the high problems of his art. Even in works of lesser importance, the master of trades and the master of arts should work together.

5. Division of Architectural Labor.

The power of invention acts together with the creative force of thought; thus the purely artistic labor of the architect differs from his scientific duties as a constructor. A division of labor is possible in many cases, and even to be desired, although union in the same person with

mastery of science and knowledge is possible. It is always necessary [illegible] constructor to be an architect as well. For the former is the realm of judgement; for the latter is the domain of creative imagination, or as in the motto of the beginning of this division, for one is the prose, and for the other the poetry of the art.

3. Designing.

To enter the domain of architecture, considered in the last division of this handbook, we have devoted to designing the attention to the end of its problem, which is the arrangement of the design made by him. We have therefore followed his work from the primary requirements and the first conception; have passed over the broad domain of his execution and his labors to build up a clear idea of the processes, to which all other training converges, the design, plan, and arrangement of the building. The important may be briefly summarized.

The plan of a building appears in the design, and in order to design a building, one must be a master of construction and a master of form. It is a matter of consideration that:--

1. An acquaintance with nature and properties of building materials and a correct knowledge of statics, to compose elementary structures and to combine them into rational systems and useful members of architectural organism.

2. Possession of fine perception, to pay due regard in conformity to teachings of traces and requirements of style of execution.

3. Addition to this knowledge of whatever may be necessary to suit effect of exposure to weather, frost, and to conform the building to the requirements of [illegible].

These principles must be secured as known in designing all buildings. He must also satisfy the second condition and be a master of form, which signifies:--

1. Innate talent and an active mind, with an earnest desire to realize and beautiful things.

2. Accurate knowledge of architecture of art, of forms and proportions of [illegible]

[illegible]

Ripe judgement and self-knowledge, to be able to [illegible]

[illegible]

mastery of science and knowledge is possible. It is always necessary for the architect to also, be a constructor; but is not required for the constructor to be an architect as well. For the former is the realm of judgement; for the latter is the demain of creative imagination, or as in the motto of the beginning of this division; for one is the prose, and for the other the poetry of the art.

6. Designing.

To enter the domain of architecture, comprised in the last division of this handbook, we have decided to accompany the architect to the end of his problem, which is the embodiment of the design made by him. We have therefore followed his work from the primary requirements and its first conception; have passed over the broad domain of his creation and his labors to build up a clear idea of the branches, to which all other trainign converges, the design, plan, and arrangement of the building. The important may be briefly summarized.

The plan of a building appears in the design, and in order to design a building, one must be a master of construction and a master of form.

To me a master of construction means:--

1. An acquaintance with nature and properties of building materials, and a correct knowledge of statics, to compose elementary structures and to combine them into rational systems and useful members of an architectural organism.

2. Possession of ripe experience, to pay due regard in construction to technics of trades and requirements of mode of execution.

3. Addition to this knowledge of whatever may be necessary to make effect of exposure to weather least, and to conform the building to requirements of sanitary science.

These branches must be assumed as known in designing and planning buildings. He must also satisfy the second condition and be a master of form, which signifies:--

1. Innate talent and an active mind, with an earnest impulse to create sublime and beautiful things.

2. Accurate knowledge of masterpieces of art, grasping the meaning of their forms, and fathoming the nature of architecture, to be equal to its problems.

Ripe judgement and self-knowledge, to be able to embody the creations of his imagination in accordance with the unchangeable laws of architecture.

Where may the architect find art forms more beautifully and completely developed than in the best architectural periods? Where may the desigg and construction of monuments be better studied, than in the styles of

great periods? These branches of training are therefore assumed. In designing and planning buildings, we have only to apply these primary branches and to draw our conclusions.

Whoever has made all these branches of science and art his intellectual property and has grasped the requirements of the problem, derived from custom, habit and from civilized life, possesses the science and knowledge, whose essence is architectural composition.

Architectural design must also combine truth of thought, beauty of form, and fulfilment of purpose. These are the primary laws, which must first be understood with perfect clearness. These were succeeded by studies of proportions in architecture, of planning buildings in general and in detail, of treatment of forms of external and internal architecture, and the more or less developed vestibules and corridors of buildings.

7. Science of Building.

This academic essay is now followed by what is briefly designated "Science of Building". This comprises thorough consideration of all kinds of buildings, arranged in divisions, each comprising several sections. The course for each species of building, after a brief glance at its historical development, is that the requirements of the building, its form of plan, treatment and arrangement are investigated and deduced from its purposes and uses, from tradition and the progress of civilization. Typical examples serve as illustrations.

The title expresses limitation to a definite creative field exclusively belonging to the architect. As structures should be classed all extensive works of engineers, bridges and tunnels, hydraulic and harbor works, compared with the works of the architect as corresponding to them, and which must be regarded as suitable objects for the effective development of architecture. Yet for convenience, a division of the work between the architect and the engineer was long since made, and we shall therefore omit structures where conditions of use and suitability do not permit requirements of art to assume control, and those in which technical conditions are to be fulfilled. But all in which artistic force predominates, or is not entirely suppressed, from the smallest problems, content with grace and effect obtained with the most limited means, up to the most important undertakings of art, for whose execution the labor of an entire generation is required, will be subjected to critical consideration, while we study their typical peculiarities.

"Architectural Composition" and "Science of Buildings" necessarily belong together and materially extend each other. We have clearly fixed the ideas of both and have limited their domains. Architectural Compo-

sition is the general and theoretical portion, the Science of Building being the special and practical part.

SECTION 1. GENERAL PRINCIPLES.

By Professor Heinrich Wagner.

8. General.

What is the nature of Architectural Composition, what does it comprise, and where did it originate? We recognize it as the result of knowledge and skill, drawn from experience and collected from the realms of science and art. But to find its origin, we must penetrate more deeply. For a proper answer to these questions, we must return to primary ideas.

To compose or design, one must first know what he would create. This is to have an idea, and this idea or mental image of the object is brought out in full clearness and representation by drawings. Architectural designing is therefore a clear representation of a creative thought. Seeking light and clearness, the mind searches for general laws of treatment, infers causes from effects, and reaches a simple ground law, the basis of all, and which prevails in the realm of art, as in that of nature. This is the eternal law of evolution, that primarily exists in creations of the organic world, which the organism calls into existence when conditions for its vitality exist, permitting it to grow and thrive, if each separate organ fulfils its function, when it assumes the form appropriate thereto. Nature takes care that this shape may be truthful and beautiful, if the organism really fulfils its life purpose.

Transferred to the domain of architecture, we have (Art. 2) deduced from this the ground law of architectural composition. It starts from that triad of ideas; fulfilment of purpose, truth of thought, and beauty of form, the roots of the tree of theory; it will develop and blossom under the influence of three fructifying forces, experience, science and art. The path to creative activity thus indicated leads through the realm of mental contemplation. But we must still limit ourselves and make prominent the chief points, which architectural design must keep in mind.

Chapter 1. Suitability and Durability.

The requirements of civilized life increase the problems of architecture infinitely, since progressive development and improvement of external and internal conditions of life produce needs of all kinds, which cause new creations in architecture, always with the impress of time. These needs of life are subject to perpetual change and are also the conditions of existence of the building; civilization is the fruitful field of its development. But its germ lies in the purpose; the impetus toward

evolution comes from its inherent law of development. From this may be [illegible]

known in two directions. In most problems, we must satisfy material and artistic requirements. What do these requirements comprise, that the building may suit its purpose most perfectly, and also, it may take part in the improving and ennobling of life and in the welfare of man?

16. Suitability.

Fulfillment of requirements for Space.

The material purpose is first expressed in suitability of the plan. This comprises the space requirements of the problem, that the number and dimensions of the rooms may satisfy the requirements prescribed for the suitability of its purpose, that their order and arrangement may suit [illegible] naturally arrange. According to their uses, the apartments in a building may be divided into two groups:--

1. Rooms for common use and for public, more or less developed in all classes of buildings, and therefore treated in a general way in the next Section of this volume;

2. Rooms for special uses, which result from the purpose of the building, and which can only be treated in considering the different kinds of buildings.

The [illegible] connecting halls, when the latter are distinct, clear, easily found, and arranged for convenient passage. The more important and imposing a room [illegible] is to be indicated and emphasized on the exterior. The less important rooms will have to recede in the design for the order and unity of the whole, and will be subordinated to the more important and [illegible] size and form primarily upon purpose, and secondly on aesthetic considerations.

evolution comes from its innate law of development. From this may be deduced all requirements for works of architecture, which make themselves known in two directions. In most problems, we must satisfy material and esthetic purposes. What do these requirements comprise, that the building may suit its purpose most perfectly, and that it may take part in the improving and ennobling of life and in the welfare of man?

8. Suitability.

Fulfilment of Requirements for Space.

The material purpose is first expressed in suitability of the work. This comprises the space requirements of the problem, that the number and dimensions of the rooms may satisfy the conditions prescribed for the building by its purpose, that their order and arrangement may suit their uses, and that the entire structure shall accord with the customs and taste of the period. These elements of the problem influence the interior organism of the building. Its purpose and its rank among the creations to which it belongs are factors, according to which its organism and essentials are developed, and the magnitude of the building and the proportion of its parts are determined. On these will likewise depend whether all parts and rooms of the building fulfil their purposes, naturally diverse. According to their uses, the apartments in a building may be divided into two groups:--

1. Rooms for common use and for passage, more or less developed in all classes of buildings, and therefore treated in a general way in the oast Section of this volume.

2. Rooms for special uses, which result from the purpose of the building, and which can only be treated in considering the different kinds of buildings.

The entire design must be organically developed from within outwards. This will occur and the building be appropriate, when each portion of the building and each room is in its proper place, when all conveniences are arranged suitably for use, in reference to each other, to the corridors and passages of the building, and to the entrances, vestibules and connecting halls, when the latter are distinct, clear, easily found, and arranged for convenient passage. The more important and imposing a room may be, the more prominent its place in the plan, and its place is to be indicated and emphasized on the exterior. The less important rooms will have to recede in the design for the order and unity of the whole, and will be sacrificed or subordinated to the more important and larger ones. Size and form primarily depend upon purpose, and secondly on esthetic considerations.

A. Building Site, Soil, and Surroundings.

With fulfilment of purpose is connected a proper choice and treatment of building site, as well as a consideration of local conditions. Not [illegible] building stands o[illegible] a mountain or in a valley, in an open area or a narrow street, whether it is under the radiant sunshine or in the snowy forest gloom. What would a Greek temple become in place of a Gothic cathedral? [illegible] lery on the market place? The palm does not grow where the oak thrives, nor the [illegible] on the place graced by the laurel! As a plant thrives in a small unfavorable spot under proper treatment, receiving the necessary [illegible] a well pro- [illegible] of the problem are fully utilized.

These points are likewise essential in the subdivision of a building. [illegible] treatment, adjusting the effect of masses of the building, proportions and dimensions of different parts and the forms of members of the struc- [illegible] quite differently against the open horizon or clear sky, than before a dark background of deep green trees, the outline being more sharply pro- [illegible] more sensitive to slight defects in form, than in the latter case. We likewise know that the perspective image differs in height and depth and that we see things otherwise than they really are, the eye being subject [illegible] Consideration of these phenomena led in the earliest times, especially in the best architectural periods, to a refinement and perfection of [illegible] ployed, and which we have recognized in their works.

B. Sanitary Requirements.

[illegible]tions in architecture are intended for the uses of life and for [illegible] the [illegible] of mankind. [illegible]

10. Building Site, Soil, and Surroundings.

With fulfilment of purpose is connected a proper choice and utilization of building site, as well as a consideration of local conditions. Not every site, nor every soil suits any building; it is important whether a building stands o a mountain or in a valley, in an open area or a narrow street, whether it is under the radiant sunshine or in the shady forest gloom. What would a Greek temple become in place of a Gothic cathedral? Why should an outlook tower be placed on the plain or a monument of victory on the market place? The palm does not grow where the oak thrives, nor the fir in the place graced by the laurel! As a plant thrives in a small unfavorable spot under proper treatment, recieving the necessary energy from circumstances favoring its development, so rises a well arranged building on a limited and unsuitable site, if the location and form of the site, the nature of the soil, and all other local conditions of the problem are fully utilized.

These points are likewise essential in the subdivision of a building, but also appear prominent externally, id the designer knows how to deduce from such restricting influences the idea of a work with characteristic treatment, adjusting the effect of masses of the building, proportions and dimensions of different parts, and the forms of members of the structure, to the site and its peculiarities. The same object will appear quite differently against the open horizon or clear sky, than before a dark background of deep green trees, the outline being more sharply prominent in the former case, the masses seeming reduced and the eye being more sensitive to slight defects in form, than in the latter case. We likewise know that the perspective image differs in height and depth and that we see things otherwise than they really are, the eye being subject to certain deceptions, to be neutralized by pleasing treatment of form. Observation of these phenomena led in the earliest times, especially in the best architectural periods, to a refinement and perfection of form, worthy of earnest study. In the creations of the present time, we apply the same laws, which the greatest masters of past art periods employed, and which we have recognized in their works

11. Sanitary Requirements.

Creations in architecture are intended for the uses of life and for the exelevation of mankind. Their purpose requires that disturbing and injurious influences of climate and country, and that unfavorable conditions at the locality be remedied and in future controlled. These sanitary requirements first comprise measured for protecting the building from such influences. These are expressed in design and arrangement of

the building, in its location, and in precautions for protection from heat of summer and cold of winter, from sunshine and from darkness of night, from penetration of rain and shock of wind. We shelter ourselves from the elements by defenses against the weather, by arrangements for quick removal of rain water from the building to prevent dampness, and from injurious evaporation, by improving neglected grounds and preventing future uncleanness.

These precautions against external influences are also in the most intimate relation to the study of the building and the elements required for life, such as light and air, heat and water. They comprise those innumerable details in the plans of the building required by safety of the health of mankind, and which increase his physical and mental well-being. They do not belong exclusively to sanitary science, but especially to the problem of architecture. They make themselves felt in the sketch for a building, for sanitary requirements are not alone expressed in the elevation and internal arrangement of the house; they especially appear in general design and construction. If the entire organism be unhealthy, the evil cannot be removed by internal and limited means.

It is therefore first necessary to see that the building is placed on a healthy site, is built of good durable and weatherproof materials, and that it be properly orientated and sheltered from prevailing winds. Walls should be of such thickness, the roof so arranged and constructed, as to afford security against destructive effects of the elements. Drainage of the building and protection from dampness are required, walls and partitions must have openings for passage and free admission of light and air. The roof is a protection from rain and sun and should have such inclination and projection, and openings in external walls should be so protected, that rain water may be kept away from the building. In hot countries, one should be protected from dazzling light and scorching heat in lofty and airy rooms, shaded portions, in cold countries having rooms of less height, easily warmed, with closely fitted and cold resisting construction.

12. Requirement of Comfort.

These are primary requisitesfor a healthy building, and must appear in the plans. If to these be added provision for the well-being and convenience of man, for the pleasure and enjoyment of life, embodying the results of progressive science and technical skill, then is the material purpose of the problem completely fulfilled. Man's unremitting endeavor to improve his existence and for freedom from limiting external conditions is satisfied. In this is the nature of man's activity in civiliza-

tion, the aim of his endeavor and toil. To this ~~xxxx, xxhe~~must correspond the building erected with regard and full knowledge thereof.

b. Durability.

13. Duration of Building.

Not only for the welfare of man must his work exhibit a sound structural organism, but it must have sufficient resistance to guarantee security against destruction by natural accidents, by time, and even by man. This is necessary for the building to fulfil its purpose satisfactorily. It must often be devised to endure for generations, for centuries, even for thousands of years, transmitted as a legacy to future ages, and useful to them. This gives another law for the creations of architecture, that of durability. Durability is also based on a requirement of feeling; for, in opposition to the transitory nature of earthly existence, it arouses a conesciousness of duration, approximates the hopes innate in mankind, a desire for the unchangeable and the eternal.

14. Building Materials and Construction.

No detailed statement of what is understood by durability is required. This demands intelligent examination and choice of materialsm both for endurance of weather, and resistance to accidental stresses. It consists in the proper use of materials in construction, in the formation of structural elements, and in the union of all parts of the structure in a properly formed building, treated in accordance with statical laws. As an essential factor materials and construction must be taken into consideration beforehand.

15. Magnitude.

Durability requires that magnitude for stability and resistance, which according to rules of science suffices for stresses, and in most cases surplus of strength to satisfy our instinctive feeling for security of the structure, against external influences and the effect of internal forces. Stability and Durability are therefore inseparable from the idea of magnitude. The structure must not only be actually stable, but must appear so; we wish primarily to see it in condition to permanently resist all destructive influences, and uncoditionally durable. Greater strength and magnitude are therefore usually required, than are prescribed by statical calculations, and are necessary, when structures for permanent use are concerned; so much the more essential, when these are works of high importance and cost, creations of monumental architecture, which must possess these characteristics in a high degree.

16. Dimensions of Rooms.

This innate feeling is justified by experience, but has also been trans-

giant structures. A just review of the monuments of the past will [illegible] in its magnitude [illegible] little greatness. The [illegible] conditions [illegible] influenced by [illegible] feeling and [illegible] they also exhibit another element of architectural composition in the most intimate relation to magnitude, which is the degree [illegible] comparing [illegible] typical buildings of the most important periods, noting these monuments only characteristic in respect to the [illegible] discussed.

[illegible] mention the pyramids of Egypt, whose sublime effect depends almost solely upon their dimensions and magnitude, though partly on [illegible] building material. We glance at their temples, which in addition to [illegible] elements [illegible] astonish us by the apparently [illegible] of their [illegible] masses of building and [illegible] the construction and their majestic repose.

How entirely different [illegible] types! [illegible] are not [illegible] employed and we also [illegible] skillful structure, [illegible] above its surroundings in [illegible]. But the mass of this monument is even in its least [illegible] vertical lines. [illegible] angle is [illegible] by its magnitude, much more so by [illegible] of the [illegible] idea, and by the [illegible] and perfection [illegible].

How different again are the not less important [illegible]. The less perfect form is intended for [illegible] is not brought to full and true expression. [illegible] columns [illegible] and intercolumniations are [illegible] system of construction is capable of the highest development and [illegible]. The arch [illegible] solid [illegible] vaults determine the subdivision and the magnitudes of masses of the building; the structure in [illegible] is [illegible]. The element of magnitude appears with imposing and overpowering effect, and characterizes the mighty buildings of the Romans who did not avoid many sacrifices to produce this important element of architectural composition.

[illegible]

mitted by tradition. A brief review of the architecture of the past will convince us of this, as its monuments are most infallible evidence. They show how in earlier generations were influenced by this feeling and how they expressed it. They also exhibit another element of architectural composition, in the most intimate relation to magnitude, which is the dimensions of rooms, which may here be considered. We must make our conclusions evident by contrasting suitable typical buildings of the most important periods, noting those monuments only characteristic in respect to the questions discussed.

We first mention the pyramids of Egypt, whose sublime effect depends almost solely upon their dimensions and magnitude, though partly on the building material. We glance at their temples, which in attition to other architectural elements, especially astonish us by the apparently eternal duration of their great masses of building and by the simplicity of their construction and their majestic repose.

How entirely different does the Greek temple appear! Material and magnitude are most effectively employed and we also recieve an impresssion of enduring strength; nothing unsafe or transitory is in the appearance of the skillful structure, enthroned above its surroundings in noble repose. But the mass of this monument is even in its least details the consistent result of a structural principle, carried out clearly and masterfully with full knowledge, the system of horizontal ceilings, which according to the law of gravity can exert only vertical pressures. The Greek temple is effective by its magnitude, much more so by clearness and truth of the creative idea, and by the beauty and perfection of its form.

How different again are the not less important masterpieces of Roman architecture! The less perfect form is intended for pomp and show, and construction is not brought to full and true expression. Architectural details borrowed from the Greeks were changed; supporting members are smaller, columns are more slender, and intercoluminations are wider. But another system of construction is capable of the highest development and appears repeatedly. The arch and solid concrete vaults determine the subdivision and the magnitudes of masses of the building; the structure in several stories is evolved. The element of magnitude appears with imposing and overpowering effect, and characterizes the mighty buildings of the Romans who did not avoid many sacrifices to produce this important element of architectural composition.

In the creations of mediaeval architecture, especially in its highest bloom, the feeling for stability and magnitude is expressed in a very different way. The feeling for magnitude did not really exist. The struct-

[illegible] is concentrated in strong and richly-treated wall piers and buttress[illegible] [illegible] extends a [illegible] arch rests upon [illegible] requires flying buttresses, [illegible] and structural [illegible] monuments [illegible] [illegible] by [illegible] than [illegible] mysterious subdivision of [illegible] and [illegible] of the building, and the skilful treatment of the [illegible]

[illegible] of the Renaissance and modern period, which [illegible] the same path has been pursued since the [illegible]

[illegible] all periods [illegible] of construction, except iron and steel [illegible] recent period [illegible] system. Yet [illegible] very important [illegible] have been [illegible] in most recent years. [illegible] led the way in this [illegible] of truth as his sole guide. Yet his science [illegible] not [illegible] him to devise [illegible] with a useful [illegible]

[illegible] economical use of material and labor and [illegible] dimensions of the [illegible]

[illegible] must [illegible] the [illegible] only of [illegible] and [illegible] of building material [illegible]

[illegible] to [illegible] and must [illegible] to the aid of [illegible] to the help of practice. [illegible] methods [illegible]

ure is concentrated in strong and richly-treated wall piers and buttresses, with dimensions in accordance with the system of vaults; but with these are arranged thin enclosing walls and maximum area of window surface; over the splendid and spacious interior extends a vault, where arch rests upon arch, and rib upon rib to transmit the thrust to fixed points of support. But the entire system requires flying buttresses, arches, and structural parts to be stable; it is often highly ingenious and perfect in form, though not intended for eternal duration and immovable resistance, therefore has a somewhat disquieting effect, since mass is lacking. But the feeling for grandeur and longing for the infinite produces its mightiest and most ennobling effect in the loftiest monument for the worship of the Diety, the heaven-aspiring dome. This appears even larger and higher than it really is, by stone masonry in thin courses, by mysterious subdivision of surfaces and masses of the building, and the skilful treatment of the ornament.

We come to the architecture of the Renaissance and modern period, which may be treated together. For the same path has been pursued since the Reformation. Much that is grand and noble has been created, skillful science and high knowledge have been developed; but these art periodshave produced no really new system of construction, except iron and steel construction of recent period, based more on material than on system. Yet in this domain very important things have been accomplished in most recent years. The Engineer, produced by our ancient guilds, led the way in this direction by taking the principle of truth as his sole guide. Yet his science is still too young, and necessary time was not allowed him to devise beautiful forms for his works and thereby create with a useful science a beautiful art. We are in the midst of this movement and cannot anticipate it. But a present tendency concerns us, one towards the most rational and economical use of material and labor and minimum dimensions of the building, resulting from force of circumstances. We must take this into account, and cannot employ magnitude and grandeur to the extent permitted to artists in earlier periods of art, and must free ourselves from this desire, based only on tradition and not on nature of building material. We shall derive benefit from past masterpieces, but must not exchange intellectual freshness and susceptibility to present requirements, for the sublime and beautiful created in the past. And if Architecture primarily consists of results of experience and tradition for thousand of years, Science has a valid claim to joint possession, and must come to the aid of experience, and theory to the help of practice. Durability depends upon material, dimensions, and construction, and the general effect is in an intimate

relation to it. Both must suit the purpose and importance of the building.

Architectural composition puts these elements to varied uses; they characterize representations of the building, both of interior and exterior. An essential sign of durability or stability is direct and visible support, of all parts of the building by firm and resisting masses, avoiding all suspended portions of the structure, arranging supports beneath supports and openings above openings. How far our instinct to make supporting parts stronger and more massive than there supported, and lower openings smaller than upper ones may take this into account, must be left to other sections of this work. But it is certain disquiet oppresses us, when piers stand over openings, and heavy masses of walls load slender iron columns. These are endurable if the supporting system is clearly indicated and well defined, if the slender iron construction is inserted in the massive stone structure and arranged independently of stone forms. Late architecture thus produced very satisfactory works.

Under all circumstances, the use of a clear system of construction is essential. The simplest structures are naturally the most durable and pleasing even in our era, which has progressed so far in technical matters. Bold constructions require at certain points stronger supporting masses, even if they do not produce a feeling of insecurity. To effectively embody a system of construction opens a wide field of activity to architectural creation. This is in subdivision of masses, fixing dimensions according to statical laws for transmission of forces to walls and piers, as well as with a uniform distribution of pressure on foundations.

Parts exposed to external injuries must have greater dimensions than protected portions. According to purpose and importance of building, dimensions are to be limited to the minimum, or correspondingly increased. Strict utilitarian buildings and those for merely temporary purposes, are made as simple or as light as possible, and those intended for longer duration are to be strong and more durable. Mass and size are indispensable to monumental buildings, even if they do not alone suffice to make the structure an art work. They are expressed in details as well as in general. If the building is to have both a material and an ideal purpose, and is to be very durable, it should not be reduced to man and the brief life alloted to him. Its parts and the entire structure must be arranged on a larger scale.

Building material is to be selected accordingly, not only with reference to its resistance, but also for its massiveness, depending on its nature and origin. Wood is more exposed to rapid destruction, especially by fire, and must be considered a more perishable material than stone. Iron is

subject to rust, and we do not yet know its durability. Monoliths and ashlars of great size make an impression of resistance and eternal duration. Smaller stones cause parts composed of them to appear larger than in reality. In determining proportionate dimensions, the actual dimension is not to be confounded with the apparent size, produced by architectural members, subdivision and result of art.

Chapter 2. Truth and Order.

The preceding treats all requirements of the building to be directly deduced from its purpose, and thus connected with practical aims of life. But problems of architecture also comprise ideal aims, and these have been touched upon, since both are connected. The law of durability favors the transition; by the construction it belongs to the realm of science, and so far as based on instinct for magnitude and size, to the domain of art also.

a. Truth.

The entire province of knowledge and science is dominated by the idea of truth. For architecture requires truth in the fulfilment of purpose and truth in the expression of the construction. Both must be characterized in the shape, form and even in the least details of the structure. This means that truth must not be concealed, but must everywhere appear.

17. Sincerity in Fulfilment of Purpose.

This consists in the arrangement of the building and in the combination of its parts into an appropriate organism, and also in the characteristic form by which its importance is expressed. For truth appears in the character of the work; true originality depends thereon. Unfortunately in architecture, truth is usually under constraint, and both monotony and elaboration frequently manifest insincerity, indolence, and unfitness. It is without purpose and therefore untrue and faulty to arrange windows and doorways in misplaced order and symmetry on the exterior, where out of place in the interior, to project buttresses from walls with nothing to support, to employ columns and pilasters to support nothing or without meaning. Yet these are by many esteemed beautiful and essential! It is no less injudicious and false to treat the facade of a hall like that of a dwelling, to subdivide it into stories with several rows of windows, to give a block of small houses the appearance of a grand palatial structure, or to suppress division into stories as much as possible, permitting columns or pilasters to extend through several stories.

This does not condemn clear grouping of the masses in a block of buildings, where series of small residences recieve united and effectual architectural treatment, each single house making itself evident, but blames

poverty of invention and monotony in architecture, long bare facades, where feeling is absorbed by visible absence of thought. Free scope is afforded to the imagination, so far as it does not degenerate in the grouping and subdivision, especially in extensive buildings. Thus in a mercantile building, where pomp and show are appropriate, it is entirely proper to combine two stories externally, internally connected as business offices, to secure larger windows for objects for exhibition, thereby serving the purpose of the building, at the same time expressing its intention.

We must adhere to this in architectural creations, and will attain this if we devote ourselves to truth and not to appearance, if we state that the window serves for light and the door for passagem not for appearance, that the cornice is a protection from rain, and is not a decoration for the cieling of the interior, that the columns are supporting parts of the structure, and not merely ornamental like a decorative frieze; in brief, if we see that each part must fulfil a definite purpose and recieve an appropriate form. We shall succeed if we arrange rooms in accordance with their purposes and importance, group less important ones, accent the chief apartments by projections, by greater height and by more noble forms. The great should not be minimized, and the small should not be made to appear great; unity must not be divided, and separate parts should not be united beneath a single roof. By such tokens is truth recognized in fulfilment of purpose. How is it expressed in construction?

18. Truth in Construction.

A characteristic of truth is that by the most diverse paths the same end is attained. If the same principle appears in the different methods of construction in architecture in preceding ages for giving form to its ideas, we recognize in it the principle of truth. We find in the best periods of architecture that the construction is expressed in its masterpiecesplaces equally with their purpose. If we sometimes meet with styles or structures where form is not in harmony with the construction, it is easy to distinguish the true from the false. We shall not take stone imitations of wooden structures in Asia Minor as models, but we must regard wise and consistent use of the material used and the system as characteristic, like the excellent systems of construction in Grecian, Roman, and Gothic architecture.

In Grecian architecture with its horizontal ceiling of stone beams, constructed of large blocks and slabs, statics assumes its simplest form in the law of gravity; rigid concrete vaults in Roman Architecture like inverted monoliths, exert no thrust; but we find in Gothic architecture generally a structure of ribbed vaults, transverse arches and arcades, com-

posed of small cut stones, where all individual stresses are equilibrated and individualized in the various parts of the construction, from which no single piece may be taken without injury. Whenever stone is used, joints and bonds are to be clearly shown, and where wood or iron is the material joints, connections, and system must be apparent. Just this makes the simple and peculiar wooden construction of mountainous regions so effective and so satisfactory. It is the same with much of our iron construction, satisfactory at the first glance in spite of its lightness; truth being expressed in the construction. Falsehood is a vice in mankind and a vice in art also.

We meet the same principle of truth everywhere, though methods differ with results to be obtained, means at our disposal, and obstacles to be surmounted. It also happens that in retaining this elementary principle, methods must be chosen according to circumstances, and these lead to results externally quite diverse. It is first to be understood, form and shape being devised later. The latter must be brought out clearly and truly, with an easily understood system of construction, which conceals or deforms nothing, but appears openly with dignity, lending to the structure life and importance, while treating the different parts in accordance with their functions.

19. Truth in Materials.

But the structural system is based on the materials. We do not describe how to build in stone, wood, or iron, nor how to determine dimensions and treat forms. Truth in construction must appear in a natural use of the building materials, which consists in having each material appear what it really is. Away with all peurile deceptions, where stone forms are imitated in wood, or metal, marble, and other costly materials are replaced by paper and paint! With false trifles and frippery, meaningless and therefore untrue! Yet rational use of a substitute material is not excluded, since even this by skill and treatment may be used in an appropriate way.

20. Degeneration.

Truth in art, as in life, may be carried too far. Great candor and sincerity frequently cause offence and are less appropriate than reticence. This is true in architecture also. Truth must not become oppressive or degenerate into rudeness and lead to exaggeration, opposed to the feeling for beauty.

b. Order.

The supreme general law in nature is order, and this is true in art and science. Research otherwise loses its starting point and the imagina-

[illegible] and beauty are connected, and beauty is [illegible] independable in art and belongs to the [illegible]

Symmetry and Balance.

The plan of the building may be symmetrical or unsymmetrical: order does not necessarily involve uniformity, but balance of masses of the building and of its members about a central point, or an axis through the centre of gravity of the design. Not strict geometrical symmetry but balance should be regarded as a canon in architectural composition. [illegible] order in art also in nature. Just as this never attains absolute [illegible] form in nature, in the inorganic or organic world, we [illegible] is not true in the leaf, twig, or tree. Even in more highly developed objects, especially in man, the completest work in nature, we find symmetry in the external form with reference to the axis of the head, but not to the internal organism. What is observed in nature may also be applied to art.

[illegible], the higher the rank assumed by the building, the more [illegible] and symmetry, or similarity of its parts along a [illegible], and under some circumstances, of its [illegible] transverse axis. The organism may show variations [illegible] important portions of the entire structure [illegible] may be symmetrically arranged without requiring [illegible] according to the importance of the building, location will [illegible] the arrangement may not be symmetrical on either side. [illegible]

[illegible] adapted in treatment to local conditions. [illegible] of the animal and vegetable kingdoms, and symmetry is [illegible] and truth. The same occurs in buildings [illegible] other places, to be harmonized with those surroundings. The [illegible] are then naturally arranged with reference to each other [illegible] and purpose, freely grouped without restraint, [illegible] as if crystallized about a centre. One then seeks to [illegible] each portion of a building like the separate crystals of a [illegible] or the flowers of a plant, only so far as its purpose [illegible] no injury.

The like occurs in the [illegible]

tion is bewildered; truth and beauty are connected, and harmony is based upon it. It is therefore indispensable in art and belongs to the laws of architectural invention.

21. Symmetry and Balance.

The plan of the building may be symmetrical or unsymetrical; order does not signify absolute similarity, but balance of masses of the building and of its members about a central point, or an axis through the centre of gravity of the design. Not strict mathematical symmetry but balance will be adopted as a guide in architectural composition. We do not undervalue symmetry or throw it aside; rightly understood, it is even more essential to order in art than in nature. Just as this never attains absolute sway over forms in nature, in the inorganic or organic world, we may not subject to it the creations of art without limitation. A crystal, leaf, flower, or fruit, exhibits two approximately symmetrical halves, but this is not true of the rock, twig, or tree, Even in more highly developed objects, especially in man, the completest work in nature, we find symmetry in the external form with reference to the axis of the head, but not in the internal organism. What is observed in nature may also be applied to art.

Therefore, the higher the rank assumed by the building, the more may we require order and symmetry, or similarity of its parts about a center, or a chief axis, and under some circumstances, of its side elevations b about a transverse axis. The organism may show variations, especially in the interior; important portions of the entire structure, like the human body, may be symmetrically arranged without requiring perfect similarity. According to the importance of the building, location will be so chosen that its arrangement may not be restricted on either side. It is otherwise for buildings of lower rank, usually limited to a fixed site. Buildings for utilitarian purposes and those for the material requirements of life must be adapted in treatment to local conditions, like creations mn the mineral and vegetable kingdoms, and symmetry is usually sacrificed to suitability and truth. The same occurs in buildings erected only on particular sites, to be harmonized with their surroundings. The different parts are then naturally arranged with reference to each other, according to location and purpose, freely grouped without restraint, or within a given space as if crystallized about a centre. One then seeks to symmetrically arrange each portion of a building like the separate crystals of a stone or the flowers of a plant, only so far as its purpose thereby suffers no injury.

The like occurs in the masterpieces of architecture. Very frequently

[illegible] that rigid symmetry [illegible] in [illegible], while in Gothic architecture only loosely grouped [illegible]. The first may be because only the monumental [illegible] are preserved, and the symmetrical arrangement [illegible] for these as [illegible] [illegible] is symmetrically arranged about [illegible] in accordance with local conditions, [illegible] and picturesqueness and are [illegible]. In reference to the second statement, [illegible]

[illegible] symmetry in details only, or omission of [illegible], where not necessary. [illegible]

From this it follows that to require rigid symmetry in [illegible] would be a fault, as it would [illegible] is the case in buildings with different [illegible] purposes and importance, [illegible]

[illegible]

[illegible] that especially in monumental buildings, symmetry may be omitted only [illegible]

[illegible] but should never for the sake of symmetry, have recourse to [illegible] like blind doors and windows, so far as possible, [illegible] the outside should be symmetrical, whether the general arrangement [illegible] regular or irregular. [illegible] in all cases be natural; neither [illegible] nor irregularity may be artificial or compulsory, or contradictions [illegible] and [illegible].

[illegible]

[illegible] order of [illegible]

is the assertion made, that rigid symmetry rules in Grecian and Roman architecture, while in Gothic architecture only freely grouped and irregular designs occurr. The first may be because only the monumental buildings of the Greeks are preserved, and the symmetrical arrangement is nobbler and more suitable for these as already explained. Yet Greece transmitted to us in the Erechtheum a very characteristic and beautiful building, consisting of a triple structure, a double temple and a caryatid porch; neither part is symmetrically arranged about an axis, but in the general design and in accordance with local conditions, they are grouped with the utmost freedom and picturesqueness and are executed with the most refined artistic feeling. In reference to the second statement, we find that the principal monument of mediaeval architecture, the Gothic cathedral, is usually symmetrically arranged about a central axis with a departure from legitimate symmetry in details only, in ommission of annexes, towers, etc., on one side, where not necessary.

From this it follows that to require rigid symmetry in many designs for buildings, would be a fault, as it would frequently transgress laws of suitability and truth. This is the case in buildings with different parts varying according to their purpose and importance, in length and breadth, and in number and height of stories. How, if at a nobleman's seat or country house the principal salon were balanced by the kitchens, the conservatory was like the stables, and the chapel was similar to the chambers and living rooms, each of equal height and symmetrically treated, so that their uses could not be externally distinguished? This would be monstrous; not only monotonous in the extreme, but deceptive and false, whether intended to ennoble the building or reduce everything to a lower level. One is perhaps suprised by such contradictions and considers them impossible; similar things are actually found in many palaces externally decorated by the orders, and are almost invariably regarded as proper and beautiful!

From these examples, easily increased in number, three things are evident: that especially in monumental buildings, symmetry may be omitted only for a definite reason; that when this occurs, one should not be discouraged thereby but should never for the sake of symmetry have recourse to absurdities like blind doors and windows; so far as possible, each separate part of the building should be symmetrical, whether the general arrangement be regular or irregular. But this must in all cases be natural; neither regularity not irregularity may be artificial or cumpolsory, or degenerate into disorder and wildness.

22. Architectural Orders.

This means order in architecture, with which must not be confounded the

[illegible]

architectural orders. They were originally evolved in an organic way, [illegible] Grecian temple, the order consists [illegible] the Greek temple, [illegible]

[illegible]

[illegible] form, subdivision and ornament. This [illegible] leads to [illegible]

the relation of architectural members which [illegible] possess no [illegible] ate, and the unity of [illegible] that [illegible] not have a loose [illegible] of accidentally [illegible] order, but unity and harmony, [illegible] the result of the [illegible], that [illegible] consist of [illegible]

[illegible]

The idea of beauty [illegible] architectural composition. In what [illegible] produce beauty? [illegible] not [illegible] that the work of the architect may be beautiful? [illegible] the conception of beauty, we must [illegible] to phenomena in art.

IV.

[illegible] In common life [illegible] speak of [illegible] according to [illegible] the beauty of a thing, [illegible] created [illegible] perfect [illegible]

[illegible]

Architectural Orders. They were originally evolved in an organic way; from the Grecian temple the Order cannot be removed from the Greek temple, for its Order is its style. Just as little as may one of its members be omitted, as for an insect or a flower, without destorying it; in both cases each part fulfils a function assigned to it in the general organism and exhibits a form adapted thereto. But there is something else in the Order on a Roman building; it is merely decorative and may be removed and transferred at pleasure or be replaced by something different, as the construction of the building is not thereby changed. Since the revival of antique architecture has so proceeded, that without strict purism one may justly say that order has by the Orders become disorder, that these serve as falsities. They are only justifiable when columns or pillars have a statical function or at least a certain importance, and their existence is h based upon the arrangement of the interior.

23. Unity.

In architectural design, order is shown in the arrangement of the building. We proceed from the inmost nucleus, from the heart of the plan, to develop the internal organism and to clothe the skeleton of the structure, to connect the parts, accenting the chief portions and making them prominent by form, subdivision and ornament. This method leads to the united organism and to unity in architecture. For in this way is made apparent the relation of architectural members, which separately possess no importance, and the unity of all parts, that one may not have a loose collection of accidentally joined parts, but an indivisable whole. Unity is based on order, but unity and harmony rule the realm of the beautiful, that innermost domain of art.

Chapter 3. Beauty and Ornament.

The idea of beauty is the highest law of architectural composition. In what directions must creation proceed to produce beauty? What belongs to each part, that the work of the architect may be beautiful? To answer these questions and fix the conception of beauty, we must again compare phenomena in nature to phenomena in art.

a. Beauty.

24. Conception of Beauty.

The idea in common life, when we speak of the beauty of a thing, varies according to the rank the object occupies in creation. We may indeed term any object created by nature beautiful in its way, since it is externally perfect; yet we justly call products of the inorganic and organic world beautiful, since they are distinguished above others of their kind, and the more fully one of these is endowed by nature, the higher is it placed,

and the greater are our requirements. Thus the crystal by its simple and regular form, by color, lustre, and behavior toward light, and the flower by its form, by the magnificence and blending of color tones, by its fragrance, and even by its organic life, produce animated and pleasant impressions. If we take the higher forms of nature, or the highest product of creation for comparison, we find perfect beauty in mankind, not only the highest example of completeness in external appearance, but the impress of his spirit, the expression of his spiritual peculiarities, and above all, we find character. A head possessing character will always prove beautiful; but a fine head is not always evidence of a noble character. Possessing the latter, one will be guided by ideas of morality and truth in all situations in life, and both are combined in the idea of beauty.

25. Architectural Style.

As with phenomena in life, so with phenomena in art; but as character is to man's life, so is style to the domain of art. Style is just as essential to beauty in art, as character to beauty in life. For style is the imprint of art processes by which creation takes form in accordance with the nature of the material treated and with the ideas of the time; or, as expressed in Semper's words; " Style is the harmonizing of art phenomena with the history of its origin, and with all the requirements and the circumstances of its existence".

Let us hear the same master in regard to the origin of architectural styles: "The ancient monuments are rightly designated as fossil shells of vanished social organisms; but they did not grow on the backs of these while they existed; nor did they shoot forth in the hidden processes of nature like coral reefs, but they are constrained works of man, who has employed on them his inderstanding, observation of nature, genius, will, desires, and powers. The free will of the creative spirit of mankind therefore enters as the most important factor into the question of the origin of architectural style, and this must indeed in his creations move within certain higher laws of tradition, of requirements, and of necessity, but it adopts this by its fine perception and realization and makes it useful. Wherever a new idea of civilization took root and was accepted as such in the general consciousness, this found architecture at its service to determine its monumental expression. Its mighty civilizing influence is always recognized, and its works were with assured purpose impressed with that stamp, which elevated them as symbols of the prevailing religious, social and political systems. Not from the architects, but rather from great regenerators of society proceeded this new impulse, when the right hour had sounded for this ".

A new architectural style is only produced by a new view of the world, the gift of a new epoch of civilization, whose world-moving idea may even be nature. Since we are on the ground created by the aqquisitions of the Renaissance, we enter completely into the inheritance of that great period, when we truly make it our own, both in science as well as art, by developing it in accordance with requirements and conditions of modern civilized life. From this will the true and beautiful architectural style of our time be derived. It also follows that all our thought must be directed to spontaneous architectural creation, and all our abilities be exerted, to contribute our own work for this high purpose. The power of the architectural profession does not suffice, while the energy and will of individuals are lacking. But scattered labor is most injurious, and it is a delusion to believe that decoration by the old can equal the invention of new ideas, or that periods without styles may be revived.

Architectural style requires a clear system of construction by our statements and all traditions. Yet this does not itself form a style although an important element. The same structural principle may be developed in different directions and form the bases of different styles. The present does not need to await an epoch-making invention of a new system of construction, as if creation of a new style were dependent thereon. Other impulses are explained in Semper's words and actually produce it. Like other elements of architecture, style depends on the building material. One may properly speak of a wooden style, a brick style, an iron style, etc., because in each of these the respective building material is indicated, since the style assumes a special character in accordance with it.

28. Building Material.

The building material is itself an effective element of beauty by the characteristics of its external appearance. Granite and syenite, by indestructibility of their nature, color and polish, cannot be replaced in monumental architecture by other materials, any more than marble, with the delicacy of its tones, its veining and its texture. Sandstone is distinguished by its dull tone, appropriate for external architecture; clay is notable for plasticity and suitability for all purposes, in plain bricks in masonry and in terra cotta and majolica for relief and color decoration. Wood has an excellent effect as internal finish by diversity of grain and color, by its capacity for polish, and by suitability for carving. Iron assumes in the mould and under the hammer the most varied artistic forms; bronze takes the highest development in form under the tool of the chaser, one not obtained in any other material, and acquires a beautiful patina, suprising in antique bronzes. Finally should be mentioned stucco as and

is beautiful and may appear only in connection with smaller, i.e. [illegible]

[illegible] beautiful than any other; its full effect only appears when [illegible] that occurs in [illegible] and musical tones. Apart [illegible], are also required in architecture; as in musical or color tones, a form is [illegible] ly effective by combination or contrast with others. The use of successive [illegible] forms has a displeasing and bewildering effect, while repetition of similar [illegible] in rhythmical sequence is [illegible] and [illegible] [illegible]

[illegible]

This is true of formal treatment in general and in detail; the subdivision of the form, by which its beauty is increased or diminished. Subdivisions must be arranged in accordance with the character of the building, [illegible] or [illegible], graceful or severe, grave or gay, according to the purpose of the structure and to other circumstances. To heighten the effect, the animated and subdivided portions must be relieved by plain and undivided surfaces, a certain economy must be employed with a certain degree of [illegible]. The correct relation between masses and openings can be regulated [illegible] its main features; it is the feeling of solidity, repose [illegible] the requirements to which due attention must [illegible] [illegible].

The treatment of the members in detail will thus be subordinate to the general subdivision, and is to be adjusted in accordance with the character of the building. This applies to the forms of structural [illegible] [illegible] parts of the building. [illegible] have neglect of measure [illegible] forms [illegible] the architectonic style; the necessity for realizing the [illegible]

[illegible] appeal to the eye, has produced smaller lines and [illegible] in the most [illegible] and [illegible]. As we [illegible] our [illegible] forms [illegible] in which architecture expresses our design in lines [illegible] of [illegible] in the most natural way, we can also consider, with slight exceptions, [illegible] are [illegible] forms based on the laws of [illegible]

20. [illegible]

[illegible] They are [illegible] composed of [illegible]

be beautiful and may appear ugly in connection with another, the converse being also true. It is quite the same as in music. One tone is in itself no more beautiful than any other; its full effect only appears when joined with others in chords, melodies and musical works. Rhythm and harmony are also required in architecture; as in musical or color tones, a form is only effective by combination or contrast with others. The use of successive novel forms has a disquieting and bewildering effect, while repetition of similar motives in rhythmical sequence is quiet and animating; though if these too frequently occur, they become exhausting and monotonous.

29. Subdivision.

This is true of formal treatment in general and in detail, the subdivision of the form, by which its beauty is increased or diminished. Subdivision must be arranged in accordance with the character of the building; simple or rich, graceful or severe, grave or gay, according to the purpose of the structure and to other circumstances. To heighten the effect, the animated and subdivided portions must be relieved by plain and undivided surfaces, a certain accenting must be employed with a certain rhythm of lines, that the correct relation between masses and openings may be retained. Harmony is again required; it is the feeling of solidity, durability, and order that fixes the requirements to which due attention must be paid in subdivision.

The treatment of the members in detail will thus be subordinated to the general subdivision, and is to be adjusted in accordance with the character of the building. This extends to the forms of structural parts of the constructive organism, and makes apparent the structural importance of the parts of the building. We cannot here neglect characteristic art forms determined by the architectural style. The necessity for resisting the same external influences and the same internal forces, and the requirement of making this conflict apparent to the eye, has produced similar lines and forms in the most diverse periods and localities. As we make known our thoughts by tones and words, so do we in architecture express our designs in lines and forms. We therefore take these forms from those originated by innate feelings of mankind, that they may be apparent and be understood in the simplest and most natural way. We can also consider, with slight exceptions, that these are just as much fixed as are forms based on the laws of nature.

30. Mouldings and Profiles.

Such forms are mouldings and such lines are profiles. They are partly composed of geometrical lines and are partly free hand. We do not designate these architectural members according to their functions. They may represent transmission of a load, a free termination, or union or separa-

be beautiful and may appear ugly in connection with another, the converse being also true. It is quite the same as in music. One tone is in itself no more beautiful than any other; its full effect only appears when joined with others in chords, melodies and musical works. Rhythm and harmony are also required in architecture; as in musical or color tones, a form is only effective by combination or contrast with others. The use of successive novel forms has a disquieting and bewildering effect, while repetition of similar motives in rhythmical sequence is quiet and animating; though if these too frequently occur, they become exhausting and monotonous.

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30. Mouldings and Profiles.

Such forms are mouldings and such lines are profiles. They are partly composed of geometrical lines and are partly free hand. We do not designate these architectural members according to their functions. They may represent transmission of a load, a free termination, or union or separa-

tion of structural parts, and curves of varied curvature, convex and concave, some bold and heavy, others delicate and graceful, alternate with angular and straight forms; the more closely these lines approximate straight lines, the more energetic should be their sweep, and beauty of form is based on well arranged graduation, on change of movement, and on the effect of light and shade.

31. Scale.

Subdivision in general and in detail is to be designed on a single scale, not based on an absolute, but a relative unit of measure, which depends on the purpose and importance of the building. Thus we properly speak of the scale of a building, and where this does not exist, of the lack of a uniform scale. Harmony occurs in Grecian architecture instead of a scale, or not quite symmetry, but harmony of the whole with its separate parts, which appears in the nearly identical ratios of the lower diameter of the column to the building, to its principal parts, and to the architectural members. The modulus replaces the scale, for it has no relation to the dimensions of the monument. Whether the temple be small or large, its proportions remain about the same, and as actually fixed by artistic invention and not by the object itself. But for the vast monuments of the Romans and especially for the creations of the middle ages, as well as for those of the Renaissance and the modern era, a fixed scale is taken as a basis, which first depends on the height of man, afterwards on the building materials. It is indeed natural to assume this scale, all our buildings being used by men, since windows, doors, balustrades, etc., are in proportion to their height, dimensions being only varied, according to whether intended for merely useful structures or those occupying higher rank and intended for assemblage of many persons.

It is just as erroneous to enlarge the architectural forms of houses and of ordinary buildings to unusual size, as to diminish those of monuments intended for extraordinary purposes, like triumphal arches, baths and theatres. If this be done, the scale and general effect of the building are changed; for it will appear smaller, the larger its scale in proportion to its absolute dimensions, and conversely. To make this evident, compare Cologne Cathedral with the Church of St. Peter at Rome. Who would believe that the latter was two and a half times the area of the former? This may be explained by magnitude of scale and of dimensions; There a narrow five-aisled interior and heaven-aspiring towers are lost in graceful details, suited to the stature of man; here is a spacious interior, decorated by colossal statues, spanned by mighty tunnel vaults with a gigantic dome over the intersection, beneath which men vanish. The Church of St. Peter indeed excels in grandeur

[illegible] effect of space, but the method of [illegible] in [illegible] after of the [illegible].

28. Proportion.

The greatest influence upon beauty of form and effect of the masses is exerted by these proportions in architecture. They [illegible] the relations of the whole to its separate parts, based on a harmonic system, and they are [illegible] connected with the subdivision and the scale, and therefore cannot be transferred to any other object [illegible]. [illegible] of [illegible] that the proportions may be in themselves correct, [illegible] [illegible] Nature shows this, when it varies the proportions [illegible] only in accordance with age and sex, the proportions of [illegible] [illegible] to the body differ in the [illegible], and [illegible].

[illegible] of the proportions of a building may not be expressed [illegible] with a rule fixed for all cases, but [illegible] [illegible], one must not [illegible] a belief that they are only determined by our feeling. Sense of proportion is [illegible] [illegible] must be trained to discover defects, [illegible] architecture of [illegible] supplies us with the [illegible] correct [illegible] model proportions. From their study, [illegible] [illegible] of harmonic relations between [illegible] openings; between [illegible] and [illegible], and between length, breadth, and height [illegible] of the structures. These ratios may be expressed in numerical values of [illegible] figures, which afford more [illegible] we [illegible] the calculation and the [illegible] of the site, or of the [illegible] and color of the object upon its [illegible], and [illegible] influence on the [illegible] [illegible]. We must not [illegible] particulars, [illegible] for [illegible] [illegible] for the [illegible] of the [illegible] paintings [illegible] [illegible] that beauty of [illegible] that [illegible] [illegible] be designed [illegible] interiors of [illegible] [illegible] the structure the [illegible] of its [illegible] are [illegible] assessed, [illegible] in detail and picturesque general effect. [illegible] that and harmonic other [illegible] [illegible] [illegible] evidence to [illegible] of their volume.

a. [illegible], must [illegible] form [illegible]

[illegible]

[illegible] of the building, which [illegible] it could not [illegible]

of effect of space, but the Cathedral of Cologne excels in spacious effect of the masses.

32. Proportions.

The greatest influence upon beauty of form and effect of the masses is exerted by these proportions in architecture. They mean the relations of the whole to its separate parts, based on a harmonic system, and they are in intimate connection with the subdivision and the scale, and therefore cannot be transferred to any other object and scale. The Church of St. Peter shows that the proportions may be in themselves correct, but may be relatively faulty. Nature shows this, when it varies the proportions of the human body in accordance with age and sex, the proportions of the head, hand, and foot to the body differ in men from boys, and in women from girls.

Therefore if the proportions of a building may not be arranged in accordance with a rule fixed for all classes, but must be selected according to circumstances, one must not yield to a delusion that they are only determined by our feeling. Sense of proportion is variously developed in men; the eye must be trained to discover defects, just as the ear finds discords. The architecture of past periods supplies us with the means in numerous monuments with model proportions. From their study, we find the proportions of a building to consist of harmonic relations between masses and openings, between flat surfaces and reliefs, and between length, breadth, and height of mass of the structure. These ratios may be expressed in numerical values or in geometrical figures, which afford most valuable data. But we cannot include in the calculation and the drawing the influence of the site, or of the scale and color of the object upon its proportions, and this influence ~~of the site~~ is very important. We must not lose the chief points of view for the problem, or a regard for the harmony of the whole. What would become of art, and what would talent do, if beauty of form could be deduced by formulae? These enable us to subdivide masses and interiors of ungraceful proportions in such a manner that the object may appear removed or lessened, and divisionof the structure or union of its parts may induce beautiful proportions in detail and a harmonious general effect. These indications require explanation, But the evidence, other connected deductions, and discussion of optical effects, must be left to a later part of this volume.

b. Ornament in Form and Color.

Ornament in relief and in color are other elements of architectural composition. These contribute much to the beauty of the building, which might in itself be beautiful without ornament, since it could not attain true beauty with ornament alone.

33. Origin of Decoration in Relief and Color.

Inclination for ornament springs from an innate impulse in men to beautify their existence. Men in the lowest stage of civilization adorn their persons and the work of their hands. From occasional festal decorations of important buildings, originally consisting of natural flowers and fruits, of ornamental vases and trophies, opening later a permanent ornamentation by the aid of art; it became a requirement of art. Imitation of nature produced artificial ornament, either relief ornament in clay, stone, or wood, or applied as colored ornament with brush and color. The elements of relief and painted decoration are in the creations of nature. But it would be an aberration of art to seek to produce an accurate imitation of nature. Each art period has therefore taken nature in its own way, and has sought in representing it by form and color to bring out the ideas of its time in characteristic expression.

34. Ornament.

Ornament undoubtedly belongs to the domain of architecture and is indispensable to its works, preferably obtaining its motives from the vegetable kingdom, though also from the animal kingdom. It is incised in the surface as linear ornament, though this is chiefly executed in color, or is carved as relief decoration in the building material itself, and it is imitated from living forms of nature with more or less freedom. Conventionalization is absolutely essential. For decoration must not sink to a slavish imitation of nature; we must know how to apply it, to modify its type in accordance with the material, to simplify and to conventionalize it. Naturalistic treatment will be less suitable, when the ornament is required to express the character of a quiet surface by a pattern or a strong rhythm. We therefore distinguish between free decorative ornament and structural decoration, the first being purely ornamental, the second expressing the construction. Decorative ornament is a free addition produced by the spontaneous feeling of mankind, whose origin was just described. It contributes to the beauty of the object by animating and decorating plain surfaces and stiff members judiciously, but is not absolutely necessary. Structural ornament proceeds from a less primitive desire of mankind, expressed by making prominent and by adorning the form of the structural part as determined by the style. It therefore extends to the actual members of the architectural organism especially to those, like the shaft of a column, a console, etc., where the conflict of different stresses in the structural system becomes apparent.

Ornament in general, especially free ornament, should in accordance with its origin always personify an idea related to the ideal significance of the building and taken from the phenomena of life and nature. Motives from plants do not suffice; animals must in part supply motives; man himself and

his forms appear in the creative realm of the artistic imagination; animal forms are even invented, formed in accordance with the rules of decoration, but which must have a justification of their existence in an apparent capacity for life. Thoughtful ornament, composed in such a manner, ennobles and animates the work; it affords food for thought; one would not become tired of it, while meaningless ornamentation, even if equally beautiful, would soon become wearisome. It is not said that everything should be covered by allegorical ornament; the more important and effective this is, the more sparingly it is to be applied. Simple rhythmic patterns are appropriate for animating the surface, as well as geometrical frets and bands to enclose it.

Structural ornament contributes to the decoration of architectural members; it has no statical function, but adjusts and lessens the conflict of stresses in architectural members. It should not conceal the leading forms, but allow them to appear in their structural significance, and lend them life and movement. Stone forms naturally prevail here. The formal treatment of every kind of ornament is entirely dependent on material and technical processes.

35. Color.

The influence of color upon architecture must also be considered, even if it be merely accessory, since it is of great importance to the effect of form. It is indeed one of the most effective and most prized elements of architectural composition, both for accenting form in the best manner and for carrying out an independent creative idea. The use of colored decoration on the pictorial imitation of an object is perfectly natural, since color appears in everything in nature, and in building materials form and color can not be separated. Its introduction is therefore justified in the representation of objects from nature and from life. This is true in reference to architecture also, since all architectural styles have obtained a polychromatic effect, partly by materials of different colors, partly by color decoration. Although external polychromy may have been largely employed only by certain nations, yet wider scope has always been accorded to it in the interiors of buildings.

36. Polychromy.

First consider the use of color in the interior, which esthetic feeling has always required. A hall, or even an important room of a building is incomplete while uncolored; color is therefore indispensable to internal architecture; nothing opposes its free development, and the modern period therefore properly makes a most extended use of it. What chiefly concerns the color treatment of the building? How is harmonious effect to be obtained? This requires a developed feeling for color and an earnest study of the polychro-

matic masterpieces of architecture; suggestions are to be taken from nature, to penetrate into the mystery of its splendor of color in the organic and inorganic world, and to derive useful applications from them. We learn that upon contrasts of colors and broken tones, upon those of primary and mixed colors, is based the harmony of colors, and if we investigate the phenomena of nature, we find primary colors prevailing in ordinary natural phenomena and in low forms, but mixed colors in higher forms.

But nature also gives us by a moderate use of its color materials a suggestion for the use of color in architecture. We conclude that a tone derives its value from its surroundings, that pure colors become quiet and harmonious with a broken ground tone, strong and brilliant with light and shade, and that mixed colors alone are monotonous and without light. We note that the latter remove the object further from the eye, the former causing it to appear nearer. These are especially applicable to use of color in the interior, but it is otherwise with the polyghromatic treatment of the external architecture. It is not in the power of the creative artists to exclude all elements, that may produce discord and injure the desired effect. For this depends upon external influences, on sky and sunlight, and on surroundings. A colored facade is like a festal garment, and the building makes a peculiar impression, as a separate decorated object, especially in rain and snow. If harmony, the primary requirement of beauty, occurs, the surroundings must be suited to the key-tone, and at least to a certain extent, polychromy must be applied to the external architecture. When this is done, wise moderation must be exercised, more than in using color in the interior.

For the polyghromatic treatment of the exterior, as well as of the interior of the building, we have the means in natural and artificial building materials of varied colors, and especially in the greatly developed technical processes of the decorative arts. The principal build ing material or the local color will give the key-tone of the harmony; the chief member will be kept in a quiet and united tone, while stronger colors are permissible for other parts. Veined materials of varied colors are effective and suitable for small enclosed surfaces, flat architectural members, unfluted shafts, etc., but when employed freely and as subdivisions, they frequently have an unquiet and disturbing effect. Light tones may be used above and dark ones below, especially in the interior, where persons and objects become more prominent before a dark background. For internal color treatment and an especially effective element in very recent years, is stained glass also properly employed

in secular architecture. In no method of coloring are colors more splendid, more beautiful, and more harmonious for interiors. Color is in both nature and art so costly that we fully enjoy its recent advancement among us, and only wish it to completely supplant the dull gray of the last decade, and that a feeling for color may more strongly affect mankind.

37. Painting and Sculpture.

Ornament and color justly belong to architecture by their origin and by use for thousands of years. It also claims the assistance of painting and sculpture, which are suited to impart to its works the highest importance. No monumental building is complete, or can be finished, without these accessories. An indication of high development of art and of the work of a master in all periods, is the assignment to creations of the sister arts the place of honor in buildings. How should architectural composition proceed? How should painting and sculpture in the service of architecture treat their works? These questions suggest further study. We merely indicate the direction from which their answers may be expected.

The architectural work is to be so designed, that it may remain without painting and sculpture, complete and beautiful in itself. It is to be decided as if paintings and sculptures did not exist, or were removed from the places assigned them by the master. He places them in the tympanum, in the frieze, in panels, and in niches, to impart to his work grace and beauty of life by living representations of the beautiful. But the works of the painter and the sculptor must be subordinated to those of the architect; they must not disturb unity and harmony, nor monumental repose of the building, and must be suited to the spaces created for them. Sculptures and paintings must correspond to the intellectual purpose of the building, conform to it in style and scale, and be in complete harmony with it in drawing, relief and color. Thus have the three formative arts wrought together in all ages, contributing to the master works of architecture. Nor will our era fail in this, either in ability or desire.

FINAL CONSIDERATIONS.

38. Application of Preceding Laws.

We have here followed theory; we have seen the tree of knowledge arise from a germ, grow by the impelling force of truth, and blossom under the power of beauty; by its law, we ascribe to the creations of architecture the highest consecration and perfection of art. How is it with the restrictions and the applications of these laws? These are the same

inviolable laws, valid in past great art periods and retained in all ages. They are known, but are also misunderstood. This especially occurs for the principal of truth. It is most commonly opposed in art, exactly as in life. For endeavor to appear otherwise than he is, is founded in the nature of man. Hence appropriateness and even true beauty commonly suffers, not alone in works of special importance. Tendency to deception is the vice of our era, and is deeply rooted; it has penetrated even into the home; we are pleased to decieve ourselves there. Is it not generally stated as a special merit, that stuccor appears to be wood, and wood looks like marble, that a principal cornice, a roof, or an ornament is so made of zinc as to appear exactly like solid stone? And all this is due to the art and brush of the painter!

39. Recent Period.

But error appears in even another direction. The time is not distant, when the perfection of architecture was thought to be the most faithful imitation of an antique building. Structures were copied, whose originals were built many centuries since under another sky, of different materials, for other purposes, and at another scale. What was the result? A so-called architectural style in accordance with the supreme law, which must consist of all possible architectural styles, that the entire history of civilization might be reflected therein, just as our modern civilization is composed of the elements of all earlier civilizations.

40. The Present.

This age has indeed some good points for it has led to more accurate knolwedge. It is now generally understood, that however great he may be, one man cannot create a style. It may be a different and better one, but is still not good. One no longer ~~copies,~~ but composes, though in the most different styles. Architecture is believed to advance, when the style is modified in accordance with fashion. Yesterday Greek or Roman was used, now it is German Renaissance or Barocco, and it will tomorrow be Romanesque or Gothic; Louis XV and perhaps Japanese must be found side by side in the same series of apartments. Whither will this lead in a rapidly-living age? Architecture has become merchandise; and adjusts itself to supply and demand. Nearly all styles are now offered; a bit is cut off from this style, one from that one, all drawn from one source under the pressure of fashion! What all earlier ages possessed, which we do not miss in the Rococo, has been lost; unity of

style is lacking. The building is a creation of the age and therefore exhibits the attire of the period.

41. The Future.

What will result from this confusion of style? how is it to be improved, and how may the taste of our era be guided in the right path? Only by holding firmly the unchangeable principles of our ancient art. But all may be truly beautiful and correct in theory, yet by practicing it one can not live. With the best principles one may suffer hunger, for the truth alone does not lead to abundance. Nothing can be opposed to the truth of this argument, so long as owners and the public only desire deception. The remedy is the teaching of better ideas, and by guidance to the straight, though toilsome path of the good, the Beautiful and the True. Who shall transform public conception of the needs of art, other than the artist? What have we done for this? We have complained, suffered, and blamed ourselves and others. We must turn about, for we waste instead of utilizing the power of past art periods; we yield and embrace electism, as it is more convenient to go with the current than swim against it. But we have lost original and spontaneous creation. To acquire facility again, we must commence the work with ourselves. For "Fine art", says Fergusson, " ia a hard task-mistress, and to obtain her rewards, men must work, and think, and exercise infinite self-control. False art isan easy, smiling dame, whose favors are readily dispensed, but worthless when obtained". We will lay hand to the work, at the same time speaking for light and truth! Even if the individual cannot do much, the entire profession may accomplish something, a generation so much the more, and that begun today may be continued tomorrow. We hope for success, a s a visible improvement and a purification of art already occurs. All conditions exist for art in fresh bloom, shining forth in the clear sunshine of a new era of beauty. The feeling for architecture has become more active, even if it has sometimes wandered from the path. The public takes a living part in its development; the architectural profession has sacrifice and inspiration and is distinguished by genuine knowledge and skill; artisans are full of energy, ability, and a wide knowledge of all expedients; we command more money than ever before, and better transportation, bringing us near the most distant countries, and while united, ought we to fail in producing art peculiar to our era, escaping from the domain of electicism and of fashion? But it is first necessary that the prevailing misconception of what is good or bad, true or false, beautiful or ugly, should end. And with this aim, we will hold fast our grand principles of arch-

tectural composition.

DIVISION II. PROPORTIONS IN ARCHITECTURE.

By Professor August Theirsch.:

42.: General.:

Laws in architecture assure the beauty of the ddifice, just as this is lessened by neglecting them.: To seek and to formulate these principles is a problem that science cannot neglect. We endeavor to find and justify its solution, the direct result of esthetic feeling.: As for proportion, it is certain and beyond all dispute, that parts of a building must bear a proper relation to each other and to the whole.: How may this relation be stated, can it be expressed by numbers, or referred to simple geometrical figures?

Relations of harmonious tones in music have been definitely arranged in numbers.: Different tones have different numbers of vibrations.: Tones harmonize when their vibrations coincide or accord.: Physicists have discovered a similarity in the effect of colors on the eye. But to deduce from this that the eye prefers certain simple ratios of magnitudes in proportions and forms is an error,: upon which numerous theories have already been wrecked.: For if two tones harmonize together and one be then slightly raised or lowered, the drum of the ear is set into complex or irregular vibrations, producing a discord.: But if a rectangle has its sides in proportion of 2 to 3, and its length be then slightly changed, the eye cannot perceive the change. Simple numerical ratios certainly participate in the proportions of ancient edifices.: Much talent and labor have ~~been~~ expended in fruitless attempts to discover simple numerical ratios to serve as a basis of the three dimensions in space of an architectural structure.: Only a few points can be given here.: Henszelmann came to the conclusion that harmony of proportions in the architectural monuments of antiquity were neither result of artistic genius nor merely accidental.: He beleived that he found the secret of the ancient ar hitects in the use of the ratio of the side to diagonal of a square, and that of side t diagonal of a cube, and with these magnitudes constructed a scale, for all dimensions of a building. Viollet-le-Duc believed that ancient architects employed three different triangles as bases of proportions; the Egyptian triangle (of the Pyramids), the right angled with equal angles, and the equilateral.: But the manner in which these figures are combined on the Arch of Titus at Rome and on the section of the Cathedral at Amiens is not convincing.:

We may say that these elements do not holg good so far.: If the law

of beauty exists in them, architecture [illegible]

the nature and hold in [illegible] as well as [illegible]

different character; have each [illegible] peculiar beauty in [illegible]

a [illegible] few succeeding variety of forms and maintaining [illegible]

the most diverse [illegible].

[illegible] of figures.

[illegible] of such a law was taken when relating [illegible]

[illegible]

proportion of a straight line and to the larger the same ratio as of that to the whole. This application to architecture is defective, since the [illegible] proportions have [illegible] relations to each other. [illegible] we will accept [illegible] and proceed further. The fixed ratio [illegible] [illegible] similarity of figures. By study of the most [illegible] [illegible], we find a [illegible] in each edifice, [illegible]

[illegible]

[illegible] and form. Innumerable different figures of simple form [illegible]

[illegible]

[illegible] of the structure in its sub-divisions. This [illegible] [illegible] to the whole is especially observed [illegible] [illegible] it is based [illegible]

[illegible].

Chapter I. Proportion in Greek Architecture.

1. The Doric Temple.

If this be true, it must appear most clearly in Doric temples, whose proportions were employed [illegible] for a [illegible]. Such complete [illegible]

[illegible]

[illegible]

[illegible] of the temple, of diameter of column, [illegible] [illegible] to height of column, etc., continually vary [illegible] [illegible] [illegible] in itself. The peculiarities [illegible]: simple numerical ratios are used for certain part [illegible], [illegible] in [illegible] temple architecture [illegible] [illegible] to complex ratios; 2, similarity of geometrical forms [illegible]

[illegible]

of beauty exists in them, architecture would be condemned to monotony. The massive and bold is justified as well as the slender and graceful. Different characters have each their peculiar beauty in nature, as in this. We seek a law tolerating variety of forms and maintaijing itself under the most diverse conditions.

43. Similarity of Figures.

A step toward the discovery of such a law was taken when Zeising treated of the golden mean, the fixed ratio that Euclid taught, when the smaller portion of a straight line has to the larger the same ratio as of that to the whole. Its applicatioj to architecture is defective, since the relative proportions have no intelligible relations to each other. But we will accept the idea and proceed further. The fixed ratio is general, as well as similarity of figures. By study of the most successful works in all periods, we fijd a basal form repeated in each edifice, and that different parts always form figures similar to each other in arrangement and form. Innumerable different figures or simple forms of masses may in themselves be termed neither beautiful nor ugly; combined arrangements are alone beautiful. Harmony first arises from repitition of the primary form of the structure in its sub-divisions. This intimate relation of individual members to the whole is especially observed in works of classic architecture and on it is based their united and harmonious appearance.

Chapter 1. Proportions in Doric Architecture.

44. The Doric Temple.

If this be true, it most appear most clearly in Doric temples, whose proportions were employed unchanged for a century. Such complete harmony of all parts was not produced elsewhere than in the columnar construction of the Grecian Doric temple. Fixed ratios were not established, but from the oldest heavy monuments at Selinus to the elegant marble temples in Attica, with firm adherence to the general arrangement and the details, we find a variation in proportions, at the first view a defect. The ratio of length to breadth of the temple, of diameter of column to its height, of height of entablature to height of column, etc., continually vary, but with few exceptions nearly every building retains harmony in its parts, presenting a harmonious effect, complete in itself. Two peculiarities are found: 1, very simple numerical ratios are used for certain parts of the building, later dissapearing in artistic temple architecture and giving place to complex ratios; 2, similarity of geometrical forms of all analogous parts, which is retained as a leading idea until later antiquity.

45. Numerical Ratios.

The following ... [illegible] ... the ... [illegible]
tion.

[illegible]

[illegible] ... to ... (Fig. ...)

... of the ... [illegible] ... the distance ... [illegible]

[illegible]

The ... [illegible] ... height of the ... to ... of architrave, or ... [illegible], equal distance between the ... [illegible] ... (Fig. ...) ... [illegible] ... of height to width of ... [illegible] ... the ... [illegible] ... the four ... columns ... before the ... that the ... columns ... [illegible]. (Fig. ...)
... with the ... [illegible] ... of the columnar ... [illegible] ... approximately ... [illegible]

[illegible]

... height of the column. ... [illegible] ... of the ... [illegible]

This ... [illegible] ... to make the ... [illegible] ... pilasters. ... [illegible] ... architecture ... [illegible] ... restrictions, ... [illegible] ... limit of height ... [illegible] ... that ... [illegible] ... that the ... of the ... [illegible]

[illegible]

The following simple numerical ratios are retained in the ancient temples.

Width and height of the cell are equal, as well as those of the pronaos.

2. Width and height of the facade of the cell, so far as externally visible, are to each other as 3 to 2. (Figs. 1,2,7)

3. Height of the columns equals twice the distance between their axes (h = 2a)

4. Height of the architrave equals one-third the distance between axes of columns, or of length of architrave blocks.

The first requirement is satisfied when height of the pronaos to the top of architrave, or to ceiling beams, equals distance between the antae or walls. (Figs. 2,5). An intention is evident to strictly retain ratio of height to width of cell of the temple in the colonnade of the facade. The four middle columns are so placed before the cell that the outer axes coincide with the external width of the cell. (Figs. 2,4,7, 9,10). With the entablature above it, this portion of the columnar facade always forms a rectangle, closely approximating to a square, Semper's unit; which $= \dfrac{\text{Height of column with entablature.}}{\text{Three times distance between axes.}}$

Since architrave and frieze are usually equal in height, it results from 3d and 4th requirements that height of the entablature, omitting the geison, is one-third height of the column. The rude temple at Selinus but partially fulfils these requirements. (According to Pliny, the height of the column was at first one-third the width of the temple). The following monuments retain these numerical ratios. Temple A at Selinus; Temple of Poseidon at Paestum; Temple of Zeus at Olympia; Temple of Athene on Egina.

These numerical ratios recommended themselves for practical reasons; the made the designing and execution easier, and were perhaps prescribed by the priests. They could not form a rule for all cases and all periods.

When architecture assumed a bolder flight and freed itself from ancient priestly restrictions, men first abandoned the limit of height of the columns and made this greater, so that the column without its abacus, or its shaft alone, attained a height h = 2a. The architrave block firmly retained till later the ratio of 1 to 3. The entablature thereby became lower in proportion to the column.—But the other law remained in force, that the parts of the building should be similar to each other and to the whole. This harmony comprises 1, the similar forms of the two principal parts, the enclosure and the nucleus, or the peristyle and the cell; 2, the repitition of the same forms and proportions in the parts of the build-

[illegible] comparison of the plans [illegible]

[illegible] the same [illegible] (Figs. 2, 15), [illegible] but are very narrow [illegible] of structural or practical [illegible] upper end [illegible] interior of the cell, or is [illegible] of all [illegible] at [illegible]

[illegible] Cell and of Temple.

[illegible] to bottom of inner [illegible] the entire [illegible] with its stylobate, form [illegible] ratio of 2 to 3 in the [illegible] style) [illegible] Fig. [illegible] To produce this [illegible] are necessary. In case of [illegible] columns and wall, lower [illegible] (Fig. [illegible] frequently lower (Fig. 5 [illegible] [illegible] (Figs. [illegible] [illegible] cell proportionately as much in [illegible] [illegible]

[illegible]

[illegible] form with the portico [illegible] exhibiting a similar [illegible] building [illegible] the cell-walls and columns [illegible] vestibule (pronaos), so do [illegible] These appear like small spaces [illegible] they are open in front and [illegible] of the cell. A closer observ[illegible] in the ratios of their mag[illegible] from a square, as does [illegible] (Figs. [illegible]). The width of the [illegible] so that of width of portico [illegible] of pronaos (measured between antae) [illegible]

Length [illegible]

[illegible] Length of [illegible] 2 to 4.

ing.

46. Ground Plan.

1. With all diversities in length and breadth, comparison of the plans shows an intention to give the outer line of the peristyle (edge of upper step) the same form as that of the interior of the cell. (Figs. 3,15). Porticos are very deep before and behind the cell, but are very narrow along its sides, an arrangement not explained on structural or practical grounds. If the diagonal of the rectangle of edge of upper step be drawn, it either coincides with the diagonal of interior of the cell, or is parallel to it. With few exceptions, this is true for the plans of all Doric temples, even for the little archaictemple-cell on the Acropolis at Selinus.

47. ~~Entablatures.~~ Facades of Cell and of Temple.

2. The facade of the cell, so far as visible, or to bottom of inner architrave, and the facade of the entire temple with its stylobate, form two similar rectangles (with the ratio of 2 to 3 in the archaic style); the cell and its peristyle have similar forms. (Fig. 4). To produce this conformity, high entablatures and stylobages are necessary in case of temples with a wide space between colonnade and cell, lower entablatures being required for temples with narrow porticos. (Figs. 6,7,8). This also explains why external entablatures are frequently lower(Fig. 9) paestum, or often higher (Fig. 10) Bassae than the internal one. In other words, the peristyle adds to the cell proportionately as much in height as in breadth.

48. Entablatures.

3. Each pair of trilyphs enclose a metope and form with the portiom of cornice above them a combination, in several ways exhibiting a similarity to the entire building, viewed from front. As the cell-walls and columns along the sides inclose a darkened vestibule (pronaos), so do triplyphs in the frieze inclose the metopes. These appear like small spaces beneath the protection of the widely projectijg roof, and they are open in front and filled with sculpture, like the pronaos of the cell. A closer observation shows that the two likewise coincide in the ratios of their magnitudes. The form of the metope varies similarly from a square, as does the opening of the pronaos. (Figs. 9,10). The width of the triglyph also bears the same ratio to width of metope, as that of width of portico, including columns and walls to width of pronaos (measured between antae). Simple numerical ratios are most common:

Temple C at Selinus, 1 to 1.

Temple of Poseidon at Paestum, 3 to 4.

Temple of Concord at Agrigentum, 2 to 5.

Temple of Athena on Aegina, 2 to 5.

Temple of Apollo at Bassae, 2 to 5.

Moreover it is therefore [illegible] metopes, and wide portions [illegible] lined triglyphs.

The [illegible] of the top of the metope is also analogous to the internal [illegible] while the projecting mutules correspond to the ceiling of the [illegible] with the [illegible] bands beneath them, actually have the same ratio to the metope, as the entablature to the wall. (Figs. 8 10). These portions of the entablature and the [illegible] with its regula were always [illegible] by their deep colour as [illegible] together. They repeated the form of the entire building on a small scale.

Further, [illegible] is to the triglyph-frieze just as the entire entablature is to the cell-walls and to the columns. Indeed, the height of projecting cornice almost invariably has the same proportion to height of the frieze (including [illegible] with [illegible]), as height of the entablature has to height of the column. Compare corresponding profiles from [illegible] Aegina, and the Parthenon. (Figs. 11, 12, 13). Thus the principal ratios between stylobate, column, and entablature, are repeated in the length and [illegible] subdivisions of the entablature.

[illegible] between the smaller and larger parts is carried out [illegible] the [illegible] correspond in outline. The portion of the column [illegible] the shaft of the column [illegible] having a diagonal [illegible] represented in Figs. 11 and 13 [illegible] diagonal sections projected on the facade of the [illegible]. The entire entablature, so far as it projects [illegible] beyond the body of the cell, and the [illegible], as well as the drip-moulding, form [illegible] (Figs. [illegible]). The extended diagonals of the facade of the cell [illegible] through the angles of these figures, thereby fixing the ratio of their length and height.

[illegible] Character of Entablature.

[illegible] of the entablature exist the following [illegible] figures [illegible] 2 times longer than high, according to an [illegible] (Fig. [illegible]). A similar rectangle always occurs in the [illegible]; a similar figure is also formed by the [illegible] of the facade, and [illegible] in the [illegible] and [illegible], which is a reduced representation of the entablature of the facade with [illegible] supports.

Temple of Concordia at Agrigentum, 2 to 3.

Temple of Athene on Egina, 3 to 5.

Temple of Apollo at Bassae, 3 to 5.

Narrow cells therefore require narrow metopes, and wide porticos demand broad triglyphs.

The band at the top of the metopes is also analgous to the internal architrave, while the projecting mutules correspoud to the ceiling of the vestibule. A comparison shows that the mutules, taken with the two bands beneath them, actually have the same ratio to the metope, as the entablature to the cell. (Figs. 9,10). These portions of the entablature and the taenia with its regula were always marked by their deep color as belouging together. They repeated the form of the entire building on a small scale.

Further, the geison is to the triglyph-frieze just as the entire entablature is to the cell-walls and to the columns. Indeed, the height of projecting cornice almost invariably has the same proportion to height of the frieze (including mutules with frieze), as height of the entablature has to height of the column. Compare corresponding profiles from Paestum, Egina, and the Parthenon. (Figs. 11, 12,13). Thus the principal ratios between stylobate, column, and entablature, are repeated in the larger and smaller subdivisions of the entablature.

But a relation between the smaller and larger parts is carried out in the projections, with especial reference to outline. The portion of the abacus projecting beyond the shaft of the column likewise forms a rectangular projection similar to that of the geison, taking a diagonal view of angle column. The profiles of capitals represented in Figs. 11 and 12 are to be considered as diagonal sections projected on the facade of the temple. The entire entablature, so far as it projects sidewise beyond the body of the cell, and the geison, as well as the drip-mouldigg, form projecting and similar figures. (Figs. 11,12). The extended diagonals of the facade of the cell usually pass through the angles of these figures, thereby fixing the ratio of their breadth and height.

49. Elevation of Entablature.

4. On the elevation of the entablature exist the following harmonies between horizontal figures. The two architrave-blocks abutting over a a column form a surface 6 times longer than high, according to an archaic rule. (Fig. 14). A similar rectangle always appears in the abacus of the capital supporting these blocks; a similar figure is also formed by the entire entablature of the facade, and it appears again in the graceful regula and guttae, which are a reduced representation of the entablature of the facade, with its six conical supports.

The form of the cornice blocks, if not height [illegible]: the height of the architrave, which is true as a rule, is the same (1 to 2?), and also as the form of the triglyphs. Therefore [illegible] of the Doric temple, [illegible]

50. The Parthenon

Only an architect of genius like Ictinus dared permit himself to depart from traditional arrangement, when he designed eight columns in the front of the Parthenon. He thereby preserved the harmony of cell and peristyle, as well as that of architrave-block and entire entablature, but thus obtained perfect harmony between the interior and the exterior of the temple, that had never occurred in the [illegible] plan. The plan (Fig. [illegible]) [illegible] entire interior enclosed by walls, just as this is again similar to exterior [illegible] possible to obtain harmony between cell and peristyle in all parts of the edifice. (Fig. [illegible]). All columns here, both with and without stylobate, [illegible] height of the cell. The facades of cell and of entire structure have form rectangles of 1 to 2 instead of 1 to 3.

In other relations, the following are obtained: ratio of height and projection of cornice to height of frieze, as well as of length and projection of entire entablature (beyond side walls of cell) to height of [illegible] that of access of central viewer diagonally.

In the establishment of the Propylaea, otherwise very similar to the Parthenon, [illegible] depth of the portico.

51. Later buildings.

The architect of the [illegible] followed the hexastyle arrangement. In the construction of the Temple of Apollo at Bassae, but the expression of boldness was carried still more than the [illegible] in earlier buildings. The character of the building is determined by form and proportion of the column. This is the only living element in the stiff construction of the structure. The diameter and diminution of the shaft, [illegible] according to the taste of the architect and the prevailing conceptions of the period. In the archaic temple, the strongly diminished shaft and the widely projecting echinus express [illegible]

The form of the cornice block, if its height be one-half the height of the architrave, which is true as a rule, is the same (1 to 8), and also as the form of the triglyph-cap. Thus on the facade of the Doric Temple, this relation is carried out in the most minute detail and is intimately connected with the number six of the columns (on facade).

50. The Parthenon.

Only an architect of genius like Iktinus dared permit himself to depart from traditional arrangement, when he assigned eight columns to the facade of the Parthenon. He thereby abandoned the harmony of cell and metope, as well as that of architrave-block and entire entablature, but thus obtained perfect harmony between the interior and the exterior of the temple, that had never occurred in the hexastyle plan. The plan (Fig. 15) shows how the inner area of cell included between columns, harmonizes with entire interior enclosed by walls, just as this is again similar to external outline of the cell, and lastly to the outer colonnade. It was thus possible to obtain harmony between cell and peristyle in all parts of the edifice. (Fig. 16). It occurrs here, both with and without stylobate, in the last case taking architrave of the inner colonnade together with height of the cell. The facades of cell and of entire structure here form rectangles of 1 to 2 instead of 2 to 3.

Of other relations, the following are retained: ratio of height and projection of cornice to height of frieze, as well as of height and projection of entire entablature (beyond side walls of cell) to height of columns. (Fig. 12). This figure gives projection of drip-moulding, and that of abacus of capital viewed diagonally.

On the entablature of the Propyleum, otherwise very similar to the Parthenon, the geison projects considerably more, corresponding to the great depth of the portico.

51. Later Buildings.

The architect of the Parthenon followed the hexastyle arrangement in the construction of the Temple of Apollo at Bassae, but the expression of boldness was varied still more than the case heretofore in buildings in Attica. The character of the edifice is determined by form and proportion of the column. This is the only living element in the stiff construction of the structure. The diameter and diminution of the shaft, the profile and projection of the echinus again vary in each temple, according to the taste of the architect and the prevailing acceptations of the period. In the archaic temple, the strongly diminished shaft and fleshy, widely projecting echinus express a high degree of energy, that the column exerts against the load of the entablature. When the columns later

[illegible] and the entablature has proportionately grown much lighter, and more ornament with moderate display of forms [illegible] ... form of capital. The skeleton of the entablature retains [illegible] the same, but refinement and weakness took the place of [illegible] and energy.

An intimate relation [illegible] existed between the diameter of different [illegible] dimensions of the building. The width of the triglyph [illegible] agrees with the lower or middle diameter of the column, [illegible] one between triglyphs are found over one intercolumniation, [illegible] triglyphs must be in proportion to metopes as are diameters of columns [illegible] observed; the progressive enlargement of the columns, [illegible] closer spacing, is repeated in the arrangement of triglyphs.

It further results from relation of width of triglyph to [illegible] tion, as stated in art. 3, that in the older buildings those [illegible] on diameters of columns.

Table of Ratios.

[illegible]		Diam. of Column to Interval	Triglyphs to Metopes
[illegible]	Temple of Poseidon at Paestum (6th cent.)	3 to 4	3 to 4
[illegible]	Temple of Hercules at Girgenti (5th cent.)	3 to 4	3 to 4
[illegible]	Temple of Athena at Aegina (5th cent.)	2 to 3	2 to 3
[illegible]	Temple of Athena at Syracuse (5th cent.)	2 to 3	2 to 3
[illegible]	Temple of Theseus at Athens (5th cent.)	3 to 4	2 to 3
[illegible]	The Parthenon at Athens (5th cent.)	2 to 3	[illegible]
[illegible]	Temple of Apollo at Nemea (4th cent.)	2 to 3	2 to 3

12. Other Proportions.

It would be [illegible] [illegible] [illegible] [illegible]

[illegible]

the monumental buildings, and in Doric temple architecture, [illegible] [illegible] [illegible] capacity of supports to resist the weight of [illegible] laid upon them.

The ratio between the height of a column and the height of the entablature resting on it may be most easily [illegible] [illegible] considered, which [illegible] [illegible] [illegible] [illegible]. The portion of entablature [illegible] [illegible] [illegible] [illegible]

became higher and the entablature was proportionally lower and lighter, men were satisfied with moderate display of force by a stumpy and lean form of capital. The skeleton of the structure remained almost exactly the same, but meagreness and weakness took the place of muscular strength and energy.

An intimate relation likewise existed between diameter of column and certain dimensions of the building. The width of the triglyph was always either half the lower or middle diameter of the column. Since two spaces between triglyphs are found over one intercolumniation, widths of the triglyphs must be in proportion to metopes as are diameters of columns to their intervals. The compressed arrangement of the columns, or their closer setting, is repeated in the arrangement of triglyphs.

It further results from relation of width of triglyph to width of portico, as stated in Art. 3, that in the older buildings these also depend on diameters of columns.

Table of Ratios.

		Diam. of Column to Interval.	Triglyph to Metope.	Width of Portico to width of Pronaos.
Temple of Poseidon at Paestum	(Mid. Diam.)	3 to 4	3 to 4	3 to 4
Temple of Hercules at Akragas	(Mid. diam.)	3 to 4	3 to 4	3 to 4
Temple of Athene on Egina . . .	(Low. diam)	3 to 5	3 to 5	3 to 5
Temple of Athene at Syracuse.	(Mid. diam.)	2 to 3	2 to 3	2 to 3
Temple of Theseus at Athens .	(Low. diam)	2 to 3	2 to 3	2 to 3
The Parthenon at Athens	(Mid. diam.)	2 to 3	2 to 3	2 to 3
Temple of Apollo at Bassae. . .	(Mid. diam.)	3 to 5	3 to 5	3 to 5

52. Other Proportions.

It would be faulty to treat colonnades only from the point of view heretofore assumed, and to not also take into consideration the ratio between masses of the supporting and supported parts. It is always the conquest of loads or victory over masses, which impresses us in looking at monumental buildings, and in Doric temple architecture, this is especially the clearly expressed capacity of supports to resist the weight of load laid upon them.

The ratio between the mass of a column and the mass of the portion of the entablature resting on it may be most easily observed, if the areas be considered, which these members of the structure occupy on the elevation. The portion of entablature between axes of two columns is of the same size as the part of entablature supported by a single column. Draw

diagonal of rectangle formed by area of the [illegible]
to the top of entablature, where it will [illegible] a distance [illegible]
ing a triangle with [illegible]
ed, whose [illegible] the given [illegible]
a base in the Parthenon [illegible]
[illegible]
in the developed [illegible] areas of the two parts approximate equality. In
the Parthenon (Fig. [illegible]) and in the temple at Bassae, entablature area
quals that of a prismatic support constructed with the upper diameter of column as a base.

Equality of volume occurs between a prism with a square base and a cylinder of equal height, if side of the prism is .886, or approximately [illegible] diameter of cylinder. Assuming as at the Parthenon, that upper diameter of the column is 7/8 of lower one, then may the cylinder constructed with average diameter of [illegible] be assumed to equal the column [illegible], and from this it results that side of a square plinth equal in volume is [illegible]
[illegible] lower diameter of column [illegible]
[illegible] constructed with [illegible] unit. This equality is likewise found in [illegible] columns of [illegible] at Olympia. (Fig. 59).

In conclusion, it may be added that of all ratios, that of equality (1 to 1) has shown itself as most important. This is found between the [illegible] parts occurring in intimate connection, as between [illegible] of capital, the [illegible] and [illegible], and also [illegible] lower diameter of column and height of architrave. Otherwise, [illegible] as [illegible] as possible, [illegible] as a ratio is a condition of good form [illegible] and [illegible].

[illegible]

[illegible] of Figures, [illegible] and regarded as a condition of good form in [illegible] the construction of [illegible] temples. It [illegible] that this [illegible] retained [illegible]
[illegible]
[illegible] of the [illegible] and [illegible] of the Greeks, [illegible] is lost in the [illegible] of his prehistoric period. [illegible] that [illegible] a rule [illegible] Grecian [illegible] must have been in use [illegible] earlier in architecture, even in Egypt during the famous [illegible] dynasty.

We should not be [illegible] review of the [illegible]
[illegible]

diagonal of rectangle formed by axes of two columns (Fig. 17) and extend it to top of entablature, where it will cut off a distance d; constructing a rectangle with this and height of column, the surface d H is formed, whose area equals area a × h of the given portion of entablature. A test of the different colonnades of Doric temples by this method shows, that in archaic monuments entablature area exceeds column area, and that in the developed style, areas of the two parts approximate equality. In the Parthenon (Fig. 18) and in the Temple at Bassae, entablature area equals that of a prismatic support, constructed with the upper diameter of column as a base d.

Equality of volume occurs between a prism with a square base and a cylinder of equal height, if side of the prism is .886, or approximately .9 diameter of cylinder. Assuming as at the Parthenon, that upper diameter of the column is .8 of lower one, then may the cylinder constructed with average diameter of .9 be assumed to equal the conical column in volume, and from this it results that side of a square pier of equal volume is .886 x .9 = .797, or .8 lower diameter of column, so that the mass of a square prism constructed with upper diameter of column equals mass of column. This equality is likewise found in less closely set colonnades of porticos of the era of Alexander, as in inner portico of southwest building at Olympia. (Fig. 19).

In conclusion, it may be added that of all ratios, that of equality (1 to 1) has shown itself as most important. This is found between two successive parts occurring in intimate connection, as between echinus and abacus of capital, the architrave and frieze, and also in most temples, between diameter of column and height of architrave. Otherwise, in parts treated as diversely as possible, equality as a ratio is a condition of good ~~form~~ compatibility, and conversely.

53. Proportions in Egyptian Architecture.

Similarity of figures, was then recognized and required as a condition of good form in architecture in the construction of Doric temples. It is not conceivable that this rule was unconsciously retained by instinct and by thoughtless repetition. It appears to have been transmitted as a secret of the craft in workshops and mechanic guilds of the Greeks. Its first establishment is lost in the darkness of the prehistoric period. We have reason to suppose that since a rule existed for Grecian sculptors, a similar one must have been in use even earlier in architecture, even in Egypt during the famous 18th dynasty.

We shall not be criticised for this review of the land of the Pharaohs. Hellenic purists are dissapearing, who hold Grecian art as a purely nat-

[illegible]

tion of the same style with Egyptian architecture.

The style of the gigantic edifices at Thebes was developed further in another direction, when the cell was surrounded by a system of colonnades and several monuments of the beginning of that great epoch exhibit the simple plan of peripteral temple, later abandoned or not noted. The most perfectly studied temple of this kind was built by Amenophis III on the island of Elephantine, and exhibits in a very striking way the prototype of the Doric temple. (Fig. 37) The cell is similar to the enclosing structure in both plan and elevation; its facade, so far as visible, [illegible] forms a rectangle with ratio of 2 to 3, its [illegible] corresponds to the [illegible] of the whole.

We likewise observe in buildings of the same era the ratio of height to [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] architecture, evidently a rule worked in stone construction at an early date. The use of diagonals of a rectangular figure for determining breadth and height of the members following it appears to have already been [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]).

Finally, the plan of temple prevailing in Egypt, with its repetition enclosures, exhibits more less clearly the general principle of repetition of primary figure. This is here given by the cell in connection with a transverse portico. (Edfou, Dendera, Esneh, etc.) This subdivision is indeed first and most clearly apparent in the temple structures of the [illegible] period. [illegible] [illegible] [illegible] [illegible] [illegible]

Pythagoras of Samos brought mathematics of Egyptian cities to Greece, so it [illegible] doubtedly, more [illegible], now unknown, transplanted the type of [illegible] architecture and principle of similarity from the land of the Nile to the shores of Greece.

Section [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of Athens and the destroyed temple on Ilissus have colonnades [illegible] of the cell, the portico and cell coincide in front view. Equal height [illegible] which were required, [illegible] in the cell of the [illegible] temple, while [illegible] of side and front differ. [illegible] the same [illegible] of cell and

ive growth of Greece and absolutely reject the assumption of an oriental or Egyptian influence. The horizon of the history of art is enlarged. The works of F. Thiersch, Roth, and of Braun, have not been in vain. The important point is that we may assume as proved and accepted the connection of the Doric style with Egyptian architecture.

The style of the gigantic edifices at Thebes was developed further in another direction, when the cell was surrounded by a system of chambers; but several monuments of the beginning of that great epoch exhibit the simple plan of peripteral temple, later abandoned or set aside. The most carefully studied temple of this kind was built be Amenophis III on the island of Elephantine, and exhibits in a very striking way the prototype of the Doric temple. (Fig.20) The cell is similar to the enclosing peristyle in both plan and elevation; its facade, so far as visible, likewise forms a rectangle with ratio of 2 to 3; its base corresponds to the sub-structure of the whole.

We likewise observe in buildings of the same era the ratio of height of architrave to its length (1 to 3), so firmly retained in Doric temple architecture, evidently a rule tested in stone construction at an early date. The use of diagonals of a rectangular figure for determining breadth and height of the members enclosing it appears to have already been common. The cavetto cornices of portals and niches are always arranged accordingly.

Finally, the plan of temple prevailing in Egypt, with its repeated enclosures, exhibits more less clearly the general principle of repitition of primary figure. This is here given by the cell in connection with a transverse portico. (Edfou, Danderah, Erment, etc.) This subdivision is indeed first and most clearly apparent in the temple structures of the Ptolemaic period. We shall therefore not go too far in saying, that as Pythagoras of Samos brought mathematics of Egyptian sages to Greeks. so in remote antiquity, architects, now unknown, transplanted the type of temple architecture and principle of similarity from the land of the Nile to the shores of Greece.

Chapter II. Proportions in Ionic Architecture.

54. Ionic Temples in Attica.

We will consider Ionic temples in Attica, then those in Asia Minor, finally examining works by Roman architects. The temple of Nike Apteros at Athens and the destroyed temple on Ilissus have colonnades only at ends of the cell; the portico and cell coincide in front view. Equal height and width were required, and as in the cell of the Doric temple, while the ratios of side and front differ. But the same similarity of cell and

[illegible]
[illegible] similarity of the inner and outer forms, high entablature and [illegible] [illegible] were required for the short cell of the Temple of Nike. (Figs. [illegible] [illegible]. The [illegible] of these parts in the Temple on Ilissus is [illegible] [illegible]
[illegible]

[illegible]
[illegible] way. The two porticos added at sides of the principal structure have [illegible] the same shape as it (ratio 2 to 3), (Fig. 24), are entirely diffe[illegible] [illegible] in dimensions, [illegible] outline (width: height), if the parapet wall o, which the caryatids stand [illegible] with them as height of supports. (Fig. 27)

[illegible]
[illegible] but are otherwise as different as possible. The architrave is [illegible] composed of horizontal bands, the frieze and the relief sculpture forms [illegible]
[illegible]
that of frieze is the same as that of extent of entablature to height [illegible] [illegible] and the lighter one of 4. 5 to 4.3 is found on the Erechtheum [illegible]. The projection of gables is also in proportion to projection of entablature in front of cell wall. Taking the cornice as including [illegible] to entire entablature, as this is to height of columns. The same proportions are repeated on a larger scale in the design of the caryatid portico; the [illegible]
[illegible] of the sculptured frieze to architrave and to crowning above it.

[illegible]

[illegible] from the preceding, the [illegible] entablature in [illegible] is composed of four courses, successively [illegible] upwards. This is shown by the temple at [illegible], (Fig. [illegible]) the Temple at [illegible], and the [illegible]
[illegible]

the ratio of the division of the entablature to the entire portion above it is likewise always constant [illegible] [illegible] Fig. 29 to construct a scale for gradual diminution for the [illegible] the height of frieze is actually greater than given by this [illegible]

portico exists in both side view and facade of the Doric temple. To obtain similarity of the inner and outer forms, high entablature and stylobate were required for the short cell of the Temple of Nike. (Figs. 21, 22). The lowness of these parts in the Temple on Ilissus is required by the oblong form of cell. (Fig. 23). Both rectangles have a ratio of 1 to 2.

The Erectheum is a remarkable example of an unsymmetrical though harmoniously arranged structure, but it obeys the law of agreement in another way. The two porticos added at sides of the principal structure have in plan the same shape as it (ratio 2 to 3), (Fig. 24), are entirely different in dimensions, level, and design, but are similar to each other in outline (width: heigh), if the parapet wall o, which the caryatids stand be taken with them as height of supports. (Fig. 27)

The entablature of this Attic-Ionic temple is in composition analagous to the Doric entablature. The architrave and frieze are equal in height, but are otherwise as different as possible. The architrave is plain or composed of horizontal bands; the frieze and its relief sculptures form a series of vertical figures. Upon it rests the cornice, just as the entablature lies on the columns, and the ratio of the height of geison to that of frieze is the same as that of height of entablature to height of columns. The heavy ratio of 1 to 3.5 is repeated on the Temple of Nike, (Fig. 25), and the lighter one of 1 to 4.3 is found on the Erectheum (Fig. 26). The projection of geison is also in proportion to projection of entablature in front of cell wall. Taking the cornice as including cymatium and roofing slab, it is again the same ratio to entire entablature, as this is to height of columns. The same proportions are repeated on a larger scale in the design of the caryatid portico; the statues bear the same proportion to substructure and to their entablature, as that of the sculptured frieze to architrave and to crowning above it.

55. Ionic Temples in Asia Minor.

Varying from the preceding, the Ionic entablature in Asia Minor is composed of four courses, successively diminishing upwards. This is shown by the temple at Priene, (Fig. 28) the Temple at Magnesia, and the Mausoleum at Halikarnassus. The ratio of architrave to frieze is the same as that of frieze to dentil band, and that of dentil band to cornice. Each member of the series has the same proportion to the succeeding one, and the ratio of any division of the entablature to the entire portion above it is likewise always constant (a geometrical series). An attempt is made in Fig. 28 to construct a scale for gradual dimunitions of the divisions. The height of frieze is actually greater than given by this method; but

a portion of the frieze is always concealed from the eye by the architrave moulding, so that the frieze therefore appears lower than it really is. It should further be noticed that the cymatium or crowning member of a division of the entablature is always in a fixed ratio to it. This is also true of the Ionic entablature found at Olympia. The same regular diminution of courses of stone and of their crowning mouldings appears on the entablature on the interior, where it is terminated by the coffers.

The plans of temples in Asia Mijor either resemble the Doric peripteral temple (Priene), retaining harmony of cell and of peristyle on the ground plan, or a second complete peristyle is employed, producing a dipteral temple. (Ephesus, Miletus). According to Vituvius, Hermogenes invented the pseudipteral temple by omitting the inner colonnade. The necessity for treating the cell and peristyle conformably then became greater, on account of the greater lightness of the portico, than in the dipteral temple. Correspondence in plan was more easily obtained than in outline, and that was only produced by cutting off a part of the cell wall by a string-course, or by separating a substructure or base from the cell. (Fig. 29.) This is shown by later Temples of Aizani, Aphrodisias, and Baalbec. In the Temple of Artemis at Ephesus, the cell appears to have had a high base decorated by sculptures and of the same height as the sculptured portion of the shafts of the columns.

58. Grecian Secular Buildijgs.

A few Greek secular edifices exhibit the same principle of harmony. On the front elevation of the Tower of Winds at Athens, the inner and outer outlines of porticos are similar to each other. (Fig. 39). The two rectangles are concentrically arranged, and the general form of the tower is arranged about the same centre. As the entablature is to the columns, so is the crowning cornice of tower, with sculptured frieze beneath it, to the tower. Entablatures of the porticos are composed of constantly diminishing parts, as in Asia Minor (Fig. 31); but they correspond in outline to the Corinthian capitals beneath them, if these are viewed diagonally. The angle of the entablature is indeed most apparent; the diagonal profile of the capital lies in the same plane with it. These two profiles harmonize in all essential points.

As the abacus of the capital is to the bell, so is the cornice to the entablature. The projection and height of these parts bear the same ratio to the parts beneath them in both figures; the outline enclosing the acanthus foliage is similar to the projecting moulding of the architrave. The same similarity of profiles of capitals and entablature is shown by the Monument of Lysicrates, but on account of the circular plan, it is

[illegible] in general but the normal profile [illegible] (Fig. 32)

[illegible] the upper member [illegible] of columns (Fig. 33) and of the bases of [illegible] [illegible] portion of [illegible] [illegible]

[illegible]

In Doric [illegible] as a rule, the mass of entablature exceed- [illegible]

[illegible]

Chapter III. Proportions in Roman Architecture.

I. Italian Temples.

[illegible] appear in Roman temple architecture, but in spite of all transformations, [illegible] The Italian temple [illegible] portico before the cell only [illegible] of a high substructure, only [illegible] placed in front. [illegible] produced here as in the [illegible] Roman [illegible] the cell and the entire edifice form [illegible] figures [illegible] Most examples also have here [illegible] which are repeated. The substructure [illegible] portico adds to its length.

[illegible] have the following [illegible] ratios of height to length:

Temple of Fortuna Virilis at Rome - - - - - - - - - - - 2 to 1

Temple of [illegible] at [illegible] - - - - - - - - - - - 1 to 1

Temple of Antoninus and Faustina at Rome - - - - - - - - 1 to 1

[illegible] is more perfect in circular temples than in any other form. [illegible] of the cell is similar to the entire structure. [illegible] stand on steps only [illegible]

not the diagonal but the normal profile that corresponds in outline. (Fig.32)

The same is also found in the Doric style. On the monument of Thrasyllus at Athens (Fig.33) and on the Temple of Artemis at Eleusis, profiles of antae-capitals harmonize generally with those of entablature. The projecting portion of abacus corresponds to projection of geison; the height of hawksbill moulding of antae-capitals with its fillets is in proportion to frieze of entablature, and the flat band to the architrave. The palmetto-band on the necking of Ionic antae and on the cell wall is analogous to the sculptured frieze of the entablature.

57. Ratio of Masses.

Finally, the ratio of masses of supports to those of loads is to be considered. In Doric colonnades as a rule, the mass of entablature exceeded the mass of column. In Attic-Ionic monuments, the columns were further loaded by a pediment, and mass of the column was therefore greater than mass of the entablature. In the Ionic porticos of Asia Minor, entablature is universally lighter than column. The lightest load rests upon the Corinthian capital. The ratio of masses is to be further considered in the case of complex buildings in stories. The upper story may be higher than the lower one, if its mass be smaller (Monument of Lysicrates, Tomb at Mylassa). The same ratio prevails here as that between mass of a statueand that of its pedestal; the latter must be the greater of the two.

Chapter III. Proportions in Roman Architecture.

58. Italian Temples.

New forms appear in Roman temple architecture, but in spite of all transformations, ancient principles still prevail. The Italian temple has a portico before the cell only and stands on a high substructure, only ascended in front. Yet the same harmony is produced here as in the Attic-Ionic temples. For the cell and the entire edifice form similar figures in side view (Fig. 34). Most rectangles also have here simple numerical proportions, which are repeated. The substructure and the entablature add as much in proportion to the height of the cell, as the projecting portico adds to its length.

The sides have the following numerical ratios (height to length):

Temple of Fortuna Virilis at Rome - - - - - - - - - - - - - - -2 to 3
Temple of Jupiter at Pompeii- - - - - - - - - - - - - - - - - -1 to 2
Temple of Antoninus and Faustina at Rome- - - - - - - - - - - -1 to 2

Harmony is more perfect in circular temples than in any other form. The visible cylinder of the cell is similar to the entire structure. (Temple of Vesta at Tivoli). If the columns stand on steps only, the cell

[illegible] a string-course [illegible]. [illegible] with similarity of [illegible] in the varied ground plans of the temples of the [illegible] period. Thus the cell is enclosed along both sides by porticoes, facades of cell and of entire building are similar to each other (temple of [illegible] and temple of [illegible] at Roman Forum). A string-course separates the cell [illegible]. The similarity of the cell [illegible] the temple of [illegible] at Spalato. (Fig. 38).

[illegible] plans of temples, like that of [illegible] (Fig. [illegible]) where the portico before the cell is narrower than that, the two still have similar forms. The portion of the [illegible] with the rectangular edifice, since the two have the same ratio of width to height, although otherwise so very different. The pediment is itself not much [illegible] with the dome covering the cylindrical portion. [illegible] of [illegible] similarity [illegible]. The [illegible] of the entire interior is repeated in the openings of the great niches. The pilasters of the upper order are grouped just like the columns and [illegible]. Finally, the [illegible] of the small altar [illegible] with the two great pilasters which [illegible] the [illegible] of the [illegible] and form in the niches of the small niches a concentric symmetrical [illegible]. (Fig. [illegible]).

[illegible]

[illegible] orders merit special notice by their original and [illegible] composition. The [illegible] to, that the two columns or pilasters enclosing the [illegible] form a figure similar to that of the [illegible] itself; the inner pair of supports carry an arch and the outer pair a horizontal entablature, [illegible] being harmonized by the [illegible] of which [illegible] height. (Fig. [illegible]).

[illegible] (Fig. [illegible]) the square is used as the [illegible] figure and is generally [illegible], though the [illegible] is rather too [illegible] [illegible] [illegible]. In the [illegible] (Fig. [illegible]) a rectangle with greater height than width and a ratio of 1 to 2 [illegible] is employed for the [illegible], for the inner and outer lines of the [illegible] engaged columns, as well as [illegible]. The [illegible] of the portal is [illegible] by the [illegible] of the [illegible], with [illegible] similar width and height. [illegible] (Fig. [illegible]) three [illegible] [illegible]-

must have a string-course in order to not seem too high. (Temple of Vesta, Rome). We meet everywhere with similarity of internal and external forms in the varied ground plans of the temples of the imperial period. When the cell is enclosed along both sides by porticoes, facades of cell and of entire building are similar to each other (Temple of Mars Ultor and Temple of Dioscuri on Roman Forum). A string-course separates the cell from the base, which is then analagous to the substructure beneath columns. The similarity of the cell to peristyle is carried farthest on the Temple of Jupiter at Baalbec. (Fig. 35).

In abnormal plans of temples, like that of Concordia at Rome, (Fig. 36) where the portico before the cell is narrower than that, the two still have similar forms. The portico of the Pantheon harmonizes with the circular edifice, since the two have the same ratio of width to height, although otherwise so very different. The pediment is itself too much inclined, but harmonizes with the dome covering the cylindrical portion. The interior of the Pantheon everywhere affords examples of beautiful harmony, possessing almost Grecian purity. The equality of height and width of the entire interior is repeated in the openings of the great niches. The pilasters of the upper order are grouped just like the columns and pilasters of the lower; the upper arrangement being repetition of the lower at half size. Finally, the columnar enclosures of the small altars harmonize with the two great pilasters which flank the mass of the pier and form on the sides of the small niches a concentric symmetrical bordering. (Fig. 37).

59. Triumphal Arches.

Triumphal arches merit special notice by their original and harmonious composition. The rule is adhered to, that the two columns or pilasters enclosing the archway must form a figure similar to that of the archway itself. The inner pair of supports carry an arch and the outer pair a horizontal entablature, this contrast being harmonized by the coincident ratios of width to height. (Fig. 38).

On the Triumphal Arch of Titus, (Fig. 39) the square is used as the basal figure and is generally retained, though the attic is rather too high, a defect avoided in the Arch of Trajam at Beneventum. On the Triumphal Arch of Trajam at Ancona, (Fig. 40) a rectangle with greater height than width and a ratio of 1 to 2 for its sides is employed for the opening, for the inner and outer lines of the adjacent engaged columns, as well as for the entire outline. The columnar order of the portal is further enclosed by the mass of the structure with proportionally similar width and height. At Hadrian's Gate in Athens, (Fig. 41) three pairs of sup-

parts with slight intervals [illegible] the principal one, the upper story re-
peating the same form.

The triumphal arches of Septimius Severus and of Constantine (Fig. 44) with triple openings, exhibit the same relation between the entrance and their adjoining passages. The principal entrance [illegible] the side openings for persons on foot, are narrower than the principal gateway, intended for riding or driving. The horizontal divisions of the Roman triumphal arch [illegible] are compared with the [illegible] of the [illegible]. The length [illegible] is [illegible] analogous [illegible] proportion in the [illegible]. [illegible] if the two columns of the attic of the principal gateway be taken along [illegible] enclose a square central area (height of columns being equal to [illegible]), and the mass of the entire structure [illegible] the attic and [illegible] of equal width. If the passage be further [illegible] by a [illegible] of [illegible] high, [illegible] with the adjacent columns, as in case of the [illegible]. The side [illegible] the form of the principal [illegible].

[illegible] height [illegible] width [illegible] is [illegible] analogous as [illegible] the middle [illegible] relatively [illegible] (Fig. 45), of the Roman [illegible] group of [illegible] similar [illegible]. In the [illegible] arrangement [illegible] the principal [illegible], and the [illegible] above the [illegible] and [illegible] raised [illegible] side [illegible]. [illegible] the [illegible] of [illegible] in [illegible]. The [illegible] of columns are as proportion as 2 : 3 : 4. The principal gateway forms a rectangle whose sides are as 3 to 4. Height of columns is twice the height of pedestal, etc.

20. Proportions of Elevation.

The relation between the parts of elevation successively above each other must still be shown. This most plainly appears in the side view of the triumphal arch. (Fig. 44). The subdivision of principal story into pedestal, column, and entablature is also repeated in the attic. The ratios of these parts of the elevation to each other are as 2 : 4 : 1. The [illegible] is a [illegible] manner. The same analogy appears in the elevation of the Incoronata at Palermo. (Fig. 45). The repetition of the design of the entire structure in its subdivisions is very clearly shown in the outline of the Temple of Fortuna Virilis (Fig. 46). The cap of substructure is a repetition of the entablature, and the base of substructure repeats the substruct-

ports with similar intervals enclose the passage way, the upper story repeating the same form.

The Triumphal Arches of Septimus Serverus and of Constantine (Fig. 42) with triple openings, exhibit the same relation between the archways and their enclosing members. For practical reasons, the side openings for persons on foot are narrower than the principal gateway, intended for riding or driving. The returned portions of the broken entablature must here be taken with the columns, when these are compared with the piers of the archway. The impost cap is even analogous in composition to the cornice. But if the two columns at the sides of the principal archway be taken alone, they enclose a square central area (height of columns being equal to distance between them), and the mass of the entire structure encloses this at the sides and top by an equal width. If the gateway be further assumed as filled by a crowd of men (6 feet high), it also becomes square and harmonizes with the adjacent columns, as in case of the other monuments. The side archways then approximate the form of the principal gateway.

Moreover, the height of attic of Arch of Constantine is so arranged as to make the middle archway relatively as high as the side archways; (Fig. 43). or the facade forms a group of three similar parts standing beside each other. As the horizontal entablature extends above the principal gateway, and the space for inscription covers the attic, so are bands of reliefs and sculptured panels placed above the side archways. Harmony in proportions of masses, but variety in treatment of analogous parts, are leading principles in Roman composition. Simple numerical ratios always participate here. The distances between the axes of columns are in proportion as 2 : 3 : 2. The principal gateway forms a rectangle whose sides are as 3 to 4; height of columns is twice the height of pedestal, etc.

60. Proportions of Elevation.

The relation between the parts of elevation successively above each other must still be shown. This most plainly appears in the side view of the triumphal arch. (Fig. 44). The subdivision of principal story into pedestal, column, and entablature is also repeated in the attic. The ratios of these parts of the elevation to each other are as 2 : 4 : 1. The pedestals of columns and of statues are subdivided in a strictly similar manner. The same analogy appears in the elevation of the Incantada at Salonica. (Fig. 45). The repitition of the design of the entire structure in its subdivisions is very clearly shown in the outline of the Temple of Fortuna Virilis (Fig. 46). The cap of substructure is a repitition of the entablature, and the base of substructure repeats the substruct-

ure itself, the profile of the base corresponding to the base of the column taken with the steps. The similarity of subdivision of the pedestal and that of the entire order is most accurate on the Arch of Septimus Severus. Compare also the shrines of the Pantheon with the minute subdivision of their bases.

81. Subdivision of Entablature.

Repitition of the general in its parts also prevails in the subdivision of the entablature. While in Grecian architecture the entablature extends upward in an arrangement corresponding to the combination of ceiling and of roof, subdivision of the Roman entablature becomes a purely external decoration. The cornice with its ornamentation here forms the chief part of the entablature and predominates over the remainder. The mouldings crowning the architrave are reduced and simplified imitations or precursors of the cornice. This harmony already occurs in the profile of the Grecian entablature; it is also very distinctly shown in profiles of Italian entablatures, and it governs the subdivision of richly sculptured marble entablatures of the Roman imperial period. In the Grecian entablatures, the upper fascia of the architrave with its mouldings and the crowning fillet is a model of the entire entablature. (See Erectheum Temple of Nike, Temple of Priene, and Tower of Winds; Figs. 23,25,28). The subdivision of the Italian entablature is such (Fig.47), that the upper fascia of architrave bears the same proportion to the mouldings crowning it, as that of frieze to cornice. (Caps over doorways at Cori and Tivoli and entablatures at Pompeii).

Both modes of subdivision have been applied to Roman profiles. The Grecian principle is followed in entablatures of Temple of the Sun by Aurelian (Fig.49), with its architrave divided in two fasciae, and of Temple of Antoninus and Faustina (Fig. 48), as well as in those of Temples of Dioscuri and of Concordia on the Roman Forum, divided in three fascias.

The Italian proportion is employed in almost all other examples now remaining; as the cornice is to the frieze, so is the crowning moulding of the architrave to upper fascia (Fig.50). The three principal divisions of the entablature, cornice, frieze, and architrave, are usually of equal height (omitting cyma of cornice), and correspondingly the crowning moulding of architrave, the upper fascia, and the middle fascia with its moulding, all form equal parts. The same contrast of moulded and plain members placed side by side and equal in height is repeated in the lower division of the cornice.

Moreover, the cornice usually bears the same proportion to the height of its lower portion as the fillet of the architrave to its moulding. (

Orders of Coliseum, of Portico of Octavia, of Shrine of the Pantheon, and of Temples of Dioscuri and of Concordia). Where the crowning moulding of the architrave has a cavetto according to custom in Asia Minor (Temple of the Sun by Aurelian (Fig. 49) and Temple at Palmyra (Fig. 51), the cyma must always be taken with the projecting cornice in the comparison. Yet this also occurred in the Pantheon, on Temple of Vespasian, and on Forum of Trajan. Where offsets of the architrave are decorated by ogee mouldings ornamented by leaves, those exhibit a regular increase in height towards the architrave cap moulding. An example of this and of the repitition of main divisions of the entablature in subdivisions of the architrave is the beautiful cornice from interior of the Pantheon above the entrance doorway (Fig. 52).

A more important relation also exists between the profile of the capital of column and that of entablature. As on the Tower of Winds at Athens (Fig. 31), the two profiles correspond in projection when viewed diagonally, as well as in subdivisions in height. The geison, either with or without the cyma, corresponds to the abacus, and the three divisions of the entablature to the three rows of leaves on the bell. The modillions that support the geison are analgous to the volutes which curve beneath the abacus. (Fig. 53) From this point of view, the Composite capital is completely justified. The minute subdivision of the cornice is especially prefigured by the bold and ornate division of the surface of the bell. The same relations are found in the plainer treatment of Roman, Doric and Tuscan orders, between profiles of the capitals of columns or pilasters and the entablature. (Fig. 54). Compare with this the Grecian example (Fig. 33).

While the Grecian style thus places large and simple forms beside each other, apparently without adjustment, but holds them in stricter dependence upon the entire structure, Roman architecture, after this conneetion is loosened, is pleased by repeatedly subdividing the parts of the entablature into forms similar to itself. The gracefulness thereby obtained affords compensation for omitted sculptured ornamentation of the Grecian entablature. (Compare profile from substructure of Temple of Mars Ultor, Fig. 55, with that of Doric capital from Theatre of Marcellus, Fig. 56).

62. Statements of Vitruvius.

As Grecian and Roman architects were guided by this primary principle, the question arises whether it has nowhere been stated? Such an important point of theory could not be kept secret and could not be assumed as self-evident. We must seek whether the basal principle was stated anywhere in the writings of the ancients. The writings of Grecian architects

and the commentaries on their temples are indeed lost, but the work by the Roman architect Vitruvius, dedicated to Octavianus, is preserved, and since this was drawn from Grecian sources, information in regard to our problem may be expected from it. He indeed spoke of this in three places, although not with all detail and clearness that might be desired, yet so plainly as to permit us to percieve that similarity of form was a transmitted law of architecture.

First, where Vitruvius speaks of the rules of Architecture in general (Book I, Chap.2), and he speaks of the construction of temples in particular (Book II, Chap.1), he requires "symmetry" to be observed. He does not mean by this the equality of two halves, making one side a duplicate of the other; no special law being needed for this. His explanation is different, and this rather arbitrary law runs thus in Gwilt's translation = " Proportion is that agreeable harmony between the several parts of a building, which is the result of a just and regular agreement of them with each other; of the height to the width, this to the length, and each of these to the whole." Thus the parts must harmonize with each other and with the whole; they must correspond to each other and to the form of the whole. By this harmony and correspondence is undoubtedly to be understood similarity of forms of the parts and of the whole.

Take the opinion of Euclid, the ancient master of geometry, Where he treats of the similarity of figures in Book VI of his Elements, he employs the word "analogous" in definitions and theorems. Thus in Theorem 4= " If triangles have equal angles, the sides opposite equal angles are analogous to each other". Cicero also rendered the word "analogia" by "proportio" in his translation of the Timaeus. Return to Vitruvius, who says (Book III, Chap.1): "The design of temples depends on symmetry, whose rules architects should be most careful to observe. Symmetry is dependent on proportion, which the Greeks call "analogia". Proportion is a close adjustment of the sizes of the different parts to each other and to the whole, as on this proper adjustment symmetry depends."

The explanation which Vitruvius gives after the definition quoted is indeed different from what might be expected, being that as in the human body, so in an architectural structure, should all parts form a definite repitition of a unit of measure. To express this, did not require that detailed definition of symmetry. Did Vitruvius possibly reproduce the Greek definition without fully understanding it? He ends the chapter with the words (omitted by Gwilt, but translated from Reber's Vitruvius): " We admire those, who, when they built the temples of the immortal gods, so arranged the parts of their works that taken separately or as a whole,

[illegible]

Chapter [illegible]. [illegible] in Early-Christian and Mediaeval Architecture.

[illegible]

[illegible]. Early Christian Basilicas.

Let us [illegible] these general principles further in the history of architecture. Paganism was overthrown, temples of the gods fell into ruin and new ones were built no longer. Religious traditions of paganism were [illegible] and extinguished by the victory of Christianity, which likewise [illegible] architectural traditions to pass into oblivion. Instead of [illegible] temples, [illegible] were [illegible] and [illegible] in buildings as [illegible], in domed structures in the [illegible] style, and in the Romanesque and Gothic [illegible] of [illegible]. If the theory of proportion be not based on caprice, but on [illegible] of the eyes, and of the spirit of the [illegible], on the laws of the [illegible], they must appear in these new domains also.

[illegible] the [illegible] of the exterior of the basilica, so that we can [illegible] no systematic [illegible]. [illegible] form and [illegible] of [illegible]. [illegible] is general, that [illegible] aisles must have the same [illegible] of height [illegible] as the centre aisle. [illegible] "[illegible] at [illegible] of [illegible]. The most important [illegible] effect of the basilicas depends on the long rows of columns" [illegible] a series of [illegible] diminishing [illegible] with regularly [illegible]. On this fact is chiefly [illegible] of the [illegible] rows of columns.

[illegible]. Early Christian Centralized Buildings.

The [illegible] of centralized structures is of a different nature. [illegible] Roman architecture were the elements of the [illegible] [illegible]. [illegible] and [illegible] in the [illegible]. [illegible] in St. Vitale at Ravenna [illegible] that the columns [illegible] figures similar to those [illegible] by the [illegible] of the dome. The same is true of the [illegible] of the Church of St. Sophia at Constantinople. The number of [illegible] in the second story is [illegible] so as to [illegible] the same proportion of height of [illegible]. For there are [illegible] in the upper story to five in the lower, while the heights of [illegible] to seven. It is scarcely necessary, to [illegible] [illegible] of the [illegible] church, [illegible] side domes.

their subdivisions have been treated in accordance with proportion and symmetry".

Chapter IV. Proportions in Early-Christian and Mediaeval Architecture.

63. Early Christian Basilicas.

Let us trace these ground principles further in the History of Architecture. Paganism was overthrown, temples of the Gods fell into ruin and new ones were built no longer. Religious traditions of paganism were broken and extinguished by the victory of Christianity, which likewise caused architectural traditions to pass into oblivion. Instead of antique temples, Christian basilicas were erected, and church architecture was steadily developed in buildings at Ravenna, in domed structures in the Byzantine Empire, and in the Romanesque and Gothic architecture of the West. If the theory of proportion be not based on caprice, but on the nature of the case, and of the spirit of the man, on the laws of the beautiful, then will it appear in these new domaijs also.

No value was placed on the exterior of the basilica, so that we can expect no systematic treatment there. Chief emphasis rests on form and treatment of the interior. The rule is general, that side aisles must have the same ratio of height to width as the centre aisle. (St. Apolliuare-in-Classe at Ravenna; Cathedral of Parenzo, Fig. 57). The most important internal effect of the basilicas depends on the long rows of columns. These exhibit in perspective a series of contiuually diminishing similar figures with regularly lessened widths. On this fact is chiefly based the beauty of the uniform rows of columns.

64. Early Christian Centralized Buildiugs.

The treatment of centralized structures is of a different nature. Already in Roman architecture were the abutments of the dome transformed into a circle of niches. These are now treated simarly to the principal space. It is found in St. Vitale at Ravenna (Fig.58) that the columns of the niches enclose figures similar to those enclosed by the great peirs of the octagon of the dome. The same is true in the apses beneath the great semi-domes of the Church of St. Sophia at Constantinople. The number of columns in the second story is increased so as to retain the same proportion of height of column to intercolumniation. For there are seven intervals in the upper story to five in the lower, while the heights of the stories are as five to seven. It is scarcely necessary to refer to the usual plan of the Byzantine church, where the main dome is accompanied by several similar side domes.

(b) Romanesque Churches.

The harmony in Romanesque churches between center and side aisles, the principal and side apses is more apparent. [illegible] and the low-arched gallery and repetitions of [illegible], like the arcade-friezes along the cornices. Frequently [illegible] are frequently fixed by the treatment of the openings. [illegible] Cathedral [illegible] nal at Autun; Church of St. Saturnin at Toulouse, Fig. 61). [illegible] in S. Zeno at Verona, the portal also repeats the same form.

(c) Gothic Churches.

We now enter the domain of the Gothic style. It differs essentially from [illegible] repetitions of towers, gables, and window tracery. The manner in which [illegible] even its most delicate twigs, [illegible] repeat a fixed form. [illegible] does not overload the [illegible] of the building, examples of simple and clear treatment are to be found, [illegible] the Church of St. [illegible] at [illegible] (Fig. 60).

The simple numerical ratios of principal dimensions are first established: height and width of three-aisled interior equal each other; width of middle aisle from center to center of piers is twice the width of side aisles. The plain facade with two towers is effective by its proportions, by the fine disposition of the masses, and invites study of the proportions.

Center lines of buttresses divide width of the facade in proportion of 2 : 3 : 2. The other lines dividing the height are governed by [illegible] which show that height of the tower to base of spire (bell story) is twice the width of base. [illegible] bell story has the ratios of 4 : 2 : 3 to this and to the spire. [illegible] The opening of the doorway, the wall area containing the portal, and the [illegible] area of the facade above this, are figures similar to that of the [illegible] of the church below bell story.

65. Romanesque Churches.

The harmony in Romanesque churches between center and side aisles, and principal and side apses is merely approximate. The round-arched frieze and the low-arched gallery are repetitions of the arch beneath them, like the triglyph-frieze above the colonnade. Proportions of the stories are frequently fixed by the treatment of the openings. Thus, where two arched openings are placed above each arch of an arcade, the upper columns have one-half the height of the lower ones. (Cathedral at Pisa; Cathedral at Autun; Church of St. Saturnin at Toulouse, Fig. 59). The similarity of side aisles to center aisle is frequently expressed in the facade. In St. Zeno at Verona, the portal also repeats the same form.

66 Gothic Churches.

We now enter the domain of the Gothic style. It differs extremely from the classic styles and completely breaks from antique traditions. It partly adheres to the older church architecture, but otherwise develops a very peculiar nature. This is that all large forms are repeated in details or imitated in smaller parts. Pinnacles, gablets and blind tracery are repetitions of towers, gables and window tracery. The manner in which these elements spring from the mass of the building corresponds to tree growth, whose branching and ramifications, even its most delicate twigs, continually repeat a fixed form. Where this does not overload the masses of the building, examples of simple and clear treatment are to be found. Thus on the Church of St. Elizabeth at Marburg. (Fig. 60).

The simple numerical ratios of principal dimensions are first emphasized: height and width of three-aisled interior equal each other; width of middle aisle from center to center of piers is twice the width of side aisles. The plain facade with two towers is effective by its proportions, by the fine appearance of the masses, and invites study of the proportions.

Center lines of buttresses divide width of the facade in proportion of 2 : 3 : 2. The chief lines dividing the height are accented by foiled bands, which show that height of the tower to base of spire (bell story) is twice the height of nave. The shaft of the tower from cornice of nave to bell story has the ratios of 4 : 2 : 5 to this and to the spire. To this larger form correspond the small towers at angles of bell story. The opening of the doorway, the wall area containing the portal, and the crntral area of the facade above this, are figures similar to that of the facade of the church below bell story.

Above the central area of the facade, whose large and rich tracery window forms the principal figure, the applied tracery with gabels and fin-

[illegible] is arranged like the mitre [illegible] successive [illegible] tire Facade. The high wall spaces of the towers with which slender windows are enclosed by masses at either end, in proportion to the [illegible] windows of the facade beneath them. Especially effective is the [illegible] reduction of masses by offsets with increasing height of the spires. The higher the stories of the buttresses, the more is their mass diminished, so that, [illegible] equality of masses results in the successive portions of the towers.

The most [illegible] is produced by [illegible] [illegible] the [illegible] greatest unity of the style. With harmony in principal lines, the greatest diversity in other parts is required to avoid monotony and produce a pleasing contrast. The capitals of the little shafts of a Gothic pier are frequently decorated by leaves which [illegible] or [illegible] bent over, [illegible] and intersect each other, just like the ribs of vaults above them: this is here given on a small scale, but is to appear on a large one.

We limit ourselves to noting that the facades with two towers for the Gothic cathedrals are subdivided to produce similar rectangles, that the central space with rose window is usually similar to the entire facade, and that heights of stories of towers either continually increase upwards, producing an aspiring movement, or diminish as the spires become narrower, like minarets in Cairo, whose beauty consists in similar proportions of stories and in the diversity of their ornamentation. The examples show that Gothic made the most extensive and frequent use of the principle of repetition of main forms in details.

Chapter 7. Proportions in Renaissance and Modern Architecture.

57. Churches in Italian Renaissance.

The Middle Ages drew to an end, chivalry and romantic poetry disappeared, the great Gothic cathedrals remained unfinished. One of the greatest changes in taste occurred. Other ideals were sought and attention was directed to [illegible] utility. [illegible] of this [illegible], the architecture of the Renaissance, [illegible] the [illegible], the [illegible] principle of architectural [illegible] applied. Whether architects [illegible] or [illegible] a theory, or consciously, [illegible] whether it was done with clear understanding or not, the former may [illegible] in the most beautiful monuments of Italian Renaissance. The same elegant proportions appear as in antiquity, [illegible] development, [illegible]

ials is arranged like the spires with their gables and pinnacles above the facade. The high wall spaces of the towers with their slender windows are enclosed by masses at sides and below, in proportion to the two windows of the facade beneath them. Especially effective is the visible reduction of masses by offsets with increased heights of the stories. The higher the stories of the buttresses, the more is their width diminished, so that approximate equality of masses results in two successive portions of the piers.

The most beautiful window tracery is composed of larger and smaller mullions, which repeat the larger, as the separate parts do the whole. With harmony in principal ideas, the greatest diversity in other parts is required to avoid monotony and produce a pleasing contrast. The capitals of the little shafts of a Gothic pier are frequently decorated by leaves whose mid-ribs or stems bend over, spring from and intersect each other, just like the ribs of vaults above them; this is here given on a small scale, but is to appear on a large one.

We limit ourselves to noting that the facades with two towers for the finest cathedrals are subdivided to produce similar rectangles, that the central space with rose window is usually similar to the entire facade, and that heights of stories of towers either continually increase upwards, producing an aspiring tendency, or diminish as the stories become narrower, like minarets in Cairo, whose beauty consists in similar proportions of stories, and in the diversity of their ornamentation. The examples show that Gothic made the most extensive and frequent use of the principle of repetition of main forms in details.

Chapter V. Proportions in Renaissance and Modern Architecture.

67. Churches in Italian Renaissance.

The Middle Ages drew to an end; chivalry and romantic poetry disappeared; the great Gothic cathedrals remained unfinished. One of the greatest changes in taste commenced. Other ideals were sought and attention was directed to classical antiquity, slightly known and but little esteemed. Admiration of this produced the architecture of the Renaissance. With the architecture of the Greeks and Romans, the ground principle of architectural proportions was again revived and applied. Whether architects first employed this in practice and afterwards in theory, or conversely, or whether it was done with clear understanding or not, the former may be true, for it certainly appears in the most beautiful monuments of the Italian Renaissance. The same elegant proportions appear as in antiquity, while harmony is no longer produced by approximation, but is geometrically exact; in its rich development, Renaissance architecture affords even

more abundant examples and proofs than do the remains of antiquity. Examples present themselves at every step taken under a guide like Buhlmann.

In church architecture, Brunelleschi introduced the same ratio of breadth to height for middle and side aisles (St. Lorenzo and St. Spirito at Florence); Baccio Pintelli exhibits these harmonies on facades of churches at Rome (Fig. 61), extending to their towers. In churches with a single aisle, for which Alberti gave a model in St. Andrea at Mantua, apses between abutments of the dome repeat the form of transverse aisle, and are in the same proportion to this, as are the smaller niches to the apses. Still more decidedly in the Church of St. Maria di Monti in Rome do the chapel openings in the piers imitate the main interior.

The subdivision of the Roman triumphal arch (outline of side division being similar to that of middle portion) reappears on the monumental tomb of Dodge Vendramini at Venice, as well as on Tombs of Prelates in St. Maria del Popolo at Rome. Subordination of lesser to principal arches occurs most simply in the cross section of the Church of St. Salvatore in Venice (Fig. 62) and is repeated in the altars and wall tombs of the church.

In centralized churches, smaller domes follow principal dome in plan and elevation (Fig. 63). The drum beneath the dome soon formed an upper story and had externally the same ratio of breadth to height as that of the entire church beneath it. Examples are St. Pietro in Montorio at Rome (Fig. 64), Consolatione at Todi by Bramante, and Church of St. Peter at Rome as designed by Michael Angelo (Fig. 65). It is a merit of Michael Angelo, that he succeeded in retaining this harmony in erecting the Church of St. Peter, when he attached to the exterior of the church a single great order of pilasters and repeated its ratio to the attic in the arrangement of the columns of the dome. (Compare similarity in outline of upper and lower stories of Roman triumphal arch Fig. 44)

68. Private Buildings in Italian Renaissance.

When we turn to private buildings in varied forms, we find the same law in all their parts, in general and in detail. A part added or prefixed to the principal mass must accord with that in its proportions. The upper story of Pitti Palace at Florence is similar to the entire building (half as long and half as high); projecting porticoes of Villa Rotonda repeat the form of the building, etc. (Fig. 66).

69. Subdivision of Facade.

This rule for subdivision of the facade was first made in Florence; as the string-course is to that story, so is the entablature to the palace. This principle was first applied on the Strozzi Palace (Fig. 67) with great success. The entire height is divided in three nearly equal parts. Each

or the two lower stories terminated with a belt-course, [illegible] and the cornice of which next beneath, occupies one-eighth part of the height of the story. Consequently in this [illegible] of three stories, the [illegible] three times the height of a belt course, and which was [illegible] of the total height. The same is true of the [illegible]. In the [illegible] at Vicenza, the lower story is [illegible] as a substructure [illegible], and the entablature is made in proportion to the two upper stories by having twice the height of a belt-course.

This is also the subdivision of most Roman palaces. The string-course that crowns the lower story and serves it as substructure, bears the same proportion to this, as does the entablature to the remainder of the façade (1 to [illegible]). The simplicity [illegible] Florence [illegible] in stone facades. The Farnese Palace is also effective, for it follows the simple division of the Strozzi Palace with an entablature in proportion to the whole as the string-courses [illegible] to the separate stories. The [illegible] height of belt course, if vertical heights are compared [illegible], but [illegible] dimensions between upper and lower edges are [illegible] the dimensions that would be fore-shortened in perspective.

[illegible] Architraves of Doors and Windows.

Rules for architraves of doors and windows exist, and are to be [illegible] only if the [illegible] opening is higher than wide. [illegible] uniform width [illegible] is [illegible]. This [illegible] more [illegible] for wide architraves or narrow openings, than for [illegible] openings wider than high. Architraves of openings having greater height than width require an extension above or below, or even both, to make the external and internal outlines similar. For rectangular openings wider than high, there is opportunity to widen the architrave, [illegible] ed by columns and their entablatures, making the external outline similar to the internal, so is the same true for Renaissance windows and portals. When a single window architrave rests directly on a string-course, this [illegible] in the treatment of the enclosing member, and there usually [illegible] of inner and outer outlines. [illegible] row of [illegible] Palace [illegible].

[illegible] and height of enclosing members are usually arranged merely in accordance with dimensions of the opening. This is the case if pilasters or half columns are also added to the architrave of uniform width, as on [illegible] (Fig. 35) and [illegible] (Fig. 36) Palaces, etc., in accordance

of the two lower stories terminates with a belt-course, which with the course of ashlar next beneath, occupies one-eight part of the height of the story. Corresponding to this and crowning all three stories, the entablature has three times the height of a belt course, and with its frieze is one-eight of the total height. The same is true of the Piccolomini Palace at Siena. On the Gondi Palace at Florence, the lower story is characterized as a substructure by a bolder rustication, and the entablature is made in proportion to the two upper stories by having twice the height of a belt-course.

This is also the subdivision of most Roman palaces. Y The string-course, that crowns the lower story and marks it a substructure, bears the same proportion to this, as does the entablature to the remainder of the facade (1 to 12 on the Negroni Palace). The simplicity and decision that distinguish Florentine are wanting in these facades. The Farnese Palace is also effective , for it follows the simple division of the Strozzi Palace and ends with an entablature in proportion to the whole as the string-courses and bands are to the separate stories. The entablature has again thrice the ehight of belt-course, if vertical heights are not compared with each other, but actual distances between upper and lower edges are taken, the dimensions that would be least fore-shortened in perspective.

70. Architraves of Doors and Windows.

Rules for architraves of doors and windows exist, and are to be referred to the antique. When a window opening is higher than wide, an enclosing architrave of uniform width is unpleasing. This absurdity is more apparent for wide architraves or narrow openings, than for narrow architraves or openings wider than high. Architraves of openings having greater height than width require an extension above or below, or even both, to make the external and internal outlines similar. For rectangylar openings wider than high, there is oppurtunity to widen the enclosing frame at the sides (Fig. 68). As the cell of the antique temple was surrounded by columns and their entablatures, making the external outline similar to the internal, so is the same true for Renaissance windows and portals. When a simple window architrave rests directly on a string-course, this participates in the treatment of the enclosing member, and there usually exists harmony of inner and outer outlines. (Window of Massini Palace at Rome).

Breadth and height of enclosigg members are usually arranged merely in accordance with diagonals of the opening. This is the case if pilasters or half columns are also added to the architrave of uniform width, as on Bartolini (Fig. 69) and Pandolfini (Fig. 65) Palaces, etc., in accordance

... the shrines ... Vignola generally employ
... diagonals for architraves of doorways, although ...
... If the breadth of the enclosing
... the side of the door, the lintel ...
... the clear height of the doorway (Figs. 71, 72) or if the open-
ing of the doorway is twice as high as wide, the height of the lintel is
... the width of the architrave.

(b) Wall Openings and Surfaces.

Proportions of wall enclosing an opening in the wall are of
... ial importance. ... most clearly shown if round-arched
... diagonals ...
... diagonals ... windows intersect ... limit-
ing line of wall surf... or they ...
... wall space ... (Fig. 7[illegible])

In the first, the wall surface is so divided by the axes of the piers
that it is proportionally ... enclosing manner, in the second, the
... mass of wall surrounding ... it ...
The first method is used on the Pitti Palace in Florence (Fig. 7[illegible]) and
... wall
... in the ...
... is retained ...
... columns ... If widths of the piers equals width
of window, then ... wall ... to height of window ...
... of Strozzi Palace. If piers are narrower than openings, as on the
...
same proportion lower than windows. In this example, the first harmony
...
...
... and Pandolfini Palaces.

(c) Arrangement of Pilasters and Columns.

The same conditions are required in subdivision of facades by orders
of pilasters. Pedestal of the pilaster is most intimately related to ped-
estal of the window beside it. They either form two figures similar to
each other, or the pilaster order encloses the window at sides and above
...
thus taking part in the enclosure. Examples of the first are given on
... (Fig. 7[illegible]), lower story of Farnesina (Fig. 7[illegible]),
...
other hand, by upper story of Farnesina (Fig. 7[illegible]), court facade of Farnese

with the shrines in the Pantheon. Peruzzi and Vignola generally employed these diagonals for architraves of doorways, although a base like that of the window was there impracticable. If the breadth of the enclosing member is one third the width of the door, the lintel with its cap is made one-third the clear height of the doorway (Figs. 71, 72) or if the opening of the doorway is twice as high as wide, the height of the lintel is twice the width of the architrave.

71. Wall Openings and Surfaces.

Proportions of wall surfaces enclosing an opening in the wall are of special importance. Proportions are most clearly shown if round-arched window openings are enlarged to rectangular form and diagonals are drawn. Either the diagonals of two adjacent windows intersect below upper limiting line of wall surfaces (Fig. 73), or they intersect the upper margin of the wall space vertically above sides of adjacent openings. (Fig. 74) In the first, the wall surface is so divided by the axes of the piers, that it is a proportionally uniform enclosing member; in the second, the entire mass of wall surrounds the opening with proportionally uniform width.

The first method is used in the Pitti Palace in Florence (Fig. 78) and with more or less accuracy by most Roman palaces with predominating wall surfaces, especially Bartolini and Pandolfini Palaces at Florence (Figs. 69 and 70) The second system is retained in Riccardi, Strozzi, Gondi, and Guadigni palaces. (Figs. 75, 79). If width of the pier equals width of the window, then is the wall above equal to height of windows (upper story of Strozzi Palace). If piers are narrower than openings, as on the Guadini Palace, height of the wall above crown of arches is also in the same proportion lower than windows. In this example, the first harmony is also produced. That the plain wall surface between and above windows must have equal widths is to be referred to the first system of harmony and it is true if height of the windows is twice their width (Pitti, Bartolini and Pandolfini Palaces).

72. Arrangement of Pilasters and Columns.

The same conditions are required in subdivision of facades by orders of pilasters. Pedestal of the pilaster is most intimately related to pedestal of the window beside it. They either form two figures similar to each other, or the pilaster order encloses the window at sides and above in accordance with its diagonals and at proportionally equal distances, thus taking part in the enclosure. Examples of the first are given on Rucellai Palace by Alberti (Fig. 77), lower story of Farnesia (Fig. 76) and Stoppani Palace, as well as Porto Palace in Vicenza; examples of the other kind, by upper story of Garnesia (Fig. 76), court facade of Farnese

Palace (Fig. 80), and principal story of Ossoli Palace, all by Peruzzi. The harmony of the window and the pedestals of pilasters or columns, in geometrical similarity, is carried out by Michael Angelo (Palace of the Senators), by Galeasso Alessi, Sansovine, and Palladio, and the principle is obeyed, that the two supports must be of forms as different as possible. Moulded window jambs are contrasted with plain pilasters, and those with half columns, Hermes figures or rusticated columns. The early Venetian Renaissance also affords beautiful examples (Scuola di S. Marco).

The same proportions also determine the arrangement of pilasters and columns combined with arcades. As on Theater of Marcellus and on Roman triumphal arches, the pair of columns or pilasters should enclose the same figure as the pair of piers (Arcades by Peruzzi and by Palladio, Fig. 81, etc.) To this harmony is due the harmonious effect of Palladio's Basilica at Vicenza, in spite of its ungraceful wide arrangement (Fig. 82); the small columns have here a treatment of their bases with an analogy to pedestals of principal order.

73. Division of Wall Surfaces.

The subdivision of surfaces of walls also requires obedience to the law, that forms of parts must correspojd to that of the whole. This is especially true of that principal portion of the wall surfaces made prominent by size or ornamentation. This is generally found in Pompeian wall paintings; it is continued by the Renaissance and is generally employed in the Rococo style. Examples are shown in the prindipalapartment of the Massimi Palace (Fig. 83), halls of the Palace of Caprarola, and in Assembly Hall of Grand Council in Doge's Palace at Venice. A very common arrangement is to place the door in one wall near an angle, thus taking as much from length of the wall as the wainscoting does from its height.

The same is true for facades, if windows form groups or divisions of different widths. On Palace del Consiglio at Padua, the central group of windows of the upper story is similar to the main portion and to the entire facade, and on Sapienza at Naples, the loggia is similar to the whole. The facade of San Lazzaro in Venice may serve as an example of a design in the Barocco style (Figs. 84, 85).

In panelling the leaves of doors, such forms are preferred as correspond to that of the entire door, and they are surrounded by mouldings that imitate the mouldings of the architrave (Doorway of the Vatican, etc.) This is especially the case in Rococo.

74. Arrangement in Detail.

Subdivision of details likewise obeys the law of analogy. Enclosures of windows with pediments are structurally treated in accordance with the

analogy of the building. Entablatures of the windows correspond to the main entablature, their projection and height being proportioned by it. As many times as the entablature goes into height of facade, just as many does entablature of window go into height of the window order (Fig. 70) Cornice and frieze of Pandolfini Palace go eight times into the total height, and entablatures of the windows repeat all members of the main entablature. and go eight times into height of window order. The corresponding proportions on Bartolini Palace (Fig. 69) are 1 to 8 and 1 to 7. Where the ground story is a substructure, the entablature corresponds to the height of the remainder of the facade. This is approximately true of Roman palaces of several stories. If the height of the window order is one-third height of facade, its entablature is one-third height of the main entablature (Sciarra and Negroni Palaces at Rome). On facades with orders of pilasters or columns, their entablatures control the lintels of the windows, if these do not take the place of the main entablature. (Fig. 76).

75. Profiles and Decorations.

Profiles also exhibit an endeavor to bring smaller parts into harmony with greater. The crowning cornice and the bed mouldings under it, together with the frieze beneath form a group, repeated in the profile of the architrave (in its upper portion or its entirety). Peruzzi and Vignola prefer to follow this mode of subdivision and to arrange the parts of the architrave in a continually diminishing series (Fig. 86). The harmony between profiles of capitals and of entablatures in the antique was again adopted. Height and projection of the bands are proportional to each other, and ornamentation of necking of pilasters is analogous to decorations of frieze. Rosettes on necking of the column correspond to the intermittent ornamentation of the triglyph-frieze, and the foliage of the capital, to a frieze covered by foliage. Beautiful examples are found in the early Venetian Renaissance, the Orders of Alberti, Bramante, etc. The Orders of Vignola and of Palladio are well known in innumerable editions and owe their popularity less to ratios expressed in entire numbers, than to prevailing harmony of different parts with each other.

Annular members beneath the abacus (Fig. 87) have the same proportion to it, as do the frieze and architrave to the cornice. At the offset in the architrave the two fascias harmonize in their equal ratios of depth to width. In Vignola's Doric entablature, the height of geison has to the frieze and architrave beneath it a ratio (1 : 4.5) similar to that of height of architrave to height of column (1 : 4). For Vignola's Ionic entablature (Fig. 88), the abacus of the volutes, the architrave mould-

ing, and the geison of the entablature, are supported by members of ogee section and of relatively equal heights. In Vignola's Corinthian Order the geison covers the rest of the entablature (1 : 6) as the abacus covers the bell of the capital (1 : 6), and approximately as the entablature is to the column (1 : 5). This law extends to subdivision of the ornamentation. The acanthus leaf is divided into distinct parts and these are likewise subdivided into lobes of similar form. Arabesque ornamentation repeats the continuous leading forms in the interlaced delicate elements. etc.

76. German Renaissance.

It is not necessary to trace this principle in the remaining architectural styles. The German Renaissance is characterized by rich combinations of different forms more than by elegant proportions. On the remarkable facade of Otto-Heinrichs-Ban in the Castle of Heidelburg (FIg. 89), strict harmony of proportion between double windows and pilaster-order occurs, with all its diversity in form, and on the characteristic old Rathans in Zurich, depressed forms of windows and wall surfaces harmonize with the whole (Fig. 90).

77. Statements of Alberti.

If we review the Renaissance, the question arises, whether the architects of that period did not clearly state that law, so faithfully obeyed in practice. As Vitruvius is witness for antiquity, so is Leo Battista Alberti of Florence (died 1372) for the 15th century. This architect was the scientific founder of the Renaissance in Italy and expressed the leading idea in another manner, through easily intelligble. The beginning of his work "De Re Edificatoria" is a chapter on "Lineamenta". This requires parts of the structure to correspond to each other in angles and lines, which is to be attained by establishing angles and lines of fixed direction and combinations. Book VI, Chap.5, gives a description of a good design ending with the words: "All things must be adjusted to fixed angles by parallel lines". (Alberti's facade of Rucellai Palace, Fig. 77). Lines and angles drawn beforehand are therefore a means of obtaining proportional forms. In this way was obtained that "Rythm of the Masses," in which Burckhardt, most thoroughly acquainted with the Renaissance finds the art idea of the Cinque Cento period.

78. Architecture of Modern Period.

If we direct our attention to masterpieces of modern architecture, these also confirm what we found in the Antique and traced through the Mediaeval period. We mention the facades of Main Guard-House and of Museum at Berlin, both by Schinkel (Fig. 91), Old Pinacothek and Propyleum in Mun-

[illegible] (Fig. 92). leaving an analysis [illegible] buildings to the reader. In the next example, the [illegible] upper [illegible] of the towers are [illegible] and the [illegible] are [illegible] so [illegible] and [illegible], that it [illegible]. Spaces are subdivided according to similarity of [illegible] a [illegible] cons or a richly treated portion of the façade [illegible] form. The form of a window corresponds to the [illegible] [illegible] etc., [illegible] on the [illegible] are [illegible] or title-pages. The decoration [illegible] to that of the entire page.

[illegible]

The dimensions of a building change their respective ratios in perspective according to the point of view. Therefore fixed numerical ratios between all three space dimensions of [illegible] can never be determined at once by the eye, although the beauty of a building is not expressed in its geometrical proportions alone, but perspective as well. [illegible] greater foreshortening [illegible] view [illegible] foreshortening [illegible]

[illegible]

ich by Klenze (Fig. 92), leaving an analysis of these buildings to the reader. In the last example, two systems of similarity are to be distinguished; the upper stories of the towers are treated similarly to the entrance portico, and the doorways are analgous to the entire towers. The rule is so evident and so general, that in innumerable modern residences, facades are subdivided according to similarity of forms. A group of windows or a richly treated portion of the facade usually repeats the main form, the form of a window corresponds to the portion of the facade to which it belongs, etc. By a correct feeling, in framing copper plate engravings, etc., margins on the ends are made wider than those on the sides, or in ornamentation of title-pages, the decoration encloses a form similar to that of the entire page.

Chapter VI. Influence of Perspective upon Proportions.

79. Perspective.

The dimensions of a building change their respective ratios in perspective according to the point of view. Therefore fixed numerical ratios between all three space dimensions of the object can never be determined at once by the eye, though the harmony of a building is not expressed in its geometrical projections alone, but perspective as well. This opposes the assumption that harmony depends on simple numerical ratios and confirms the theory of analogy and similarity of forms. These also occur in the foreshortened view. Since this is a comparison of forms, which lie in the same or in parallel planes, these parallel dimensions are foreshortened equally within certain limits. In greater foreshortening of a facade, if widths and heights of parts are compared, the eye no longer recognizes even great differences, and the perspective view then exhibits approximate similarity of the parts to the whole, which does not in reality exist. The facade then possesses harmony when foreshortened, which is wanting in a front view, a phenomenon not infrequently observed. Vertical divisions are least changed in perspective; ratios of divisions in the height to each other, and their repetition in subordinate members appear most plainly in strongly foreshortened facades.

80. Theory of Similarity.

Since all objects may appear in perspective, a glance at perspective from the stand-point of the theory of similarity may be in place. Two general and well known phenomena are important:

1. A uniform series of equal intervals changes into a series of continually decreasing intervals.

2. Similar objects, repeated beyond each other and similarly located, are geometrically similar forms.

The beauty of the unit [illegible] is generally based on th[illegible] of its perspective appearance, when the divisions [illegible] approximately a : b :: b : c :: c : d; etc. (Double ratio of New Geometry.) [illegible] groups, [illegible] not possess this beauty; for relations of two successive parts are confused in per-[illegible] preference [illegible] important part [illegible] in interior.

These continued equal intervals excite an impression with a repetition of [illegible] effect of a passage between columns, a vaulted hall, or the interior of a church, is more imposing the further these repetitions of similar figures are continued. It is conceivable that our eyes have become so accustomed to regard equal figures as nearly similar, that even if a figure be repeated at an actually reduced scale, this agreement is at once recognized and an impression of harmony thereby created.

(Rhythm. [illegible])

c. Repetitions in Organic Nature.

When such a law is manifested in diversity of appearance, one must seek its basis. Let us attempt to penetrate further into the mystery. A prominent writer on Sculpture has said: "Sculpture is an imitation of human [illegible]." [illegible] offers geometric elements, and organic nature affords in plants, especially in the growth of trees, a model or a repetition of the primary form in the individual parts, the law of similarity and proportion. The entire form of the tree reappears in the branch; it even frequently appears in the form of the leaf or of the fruit. This repetition in plants results from growth, the first delicate twig increasing to branches and the tree becoming a complete organism. The completed building may be termed an organism. The whole grows out of a typical form and develops into numerous variations.

But another reason for the pleasing effect is based on the activity of the mind and consists in composing an image of the whole from views at different points. The results of the relation [illegible] willingly does the eye follow the lines, and the more easily is the internal intellectual image constructed. Mere similarity of form without [illegible] requires this law to be supplemented by contrast, and contrast is to be [illegible] only appears irritating or even ridiculous.

The beauty of the unifrom series is generally based on this property of its perspective appearance, when the divisions are so arranged, that approximately a : b :: b : c ::d, etc. (Double ratio of New Geometry). All other series, like those in periods or ~~groups~~, do not possess this beauty; for relations of two successive parts are confused in perspective. Hence monumental art always prefers a series uniformly continued in a straight or curved line. An important part is played in interiors, where these continued equal intervals exist in connection with a repetition of the cross section of the room in continually lessening dimensions. Space effect of a passage between columns, a vaulted hall, or the interior of a church, is more imposing, the further these repetitions of similar figures are continued. It is conceivable that our eyes have become so accustomed to regard equal figures as nearly similar, that even if a figure be repeated at an actually reduced scale, this agreement is at once recognized and an impression of harmony thereby created.

Final Considerations.

81. Proportions in Organic Nature.

When such a law is manifested in diversity of appearance, one must seek its basis. Let us attempt to penetrate further into the mystery. A prominent writer on Esthetics has said: "Sculpture is an imitation of human, and Architecture is an imitation of Plant forms." Inorganic nature supplies geometrical elements, and organic nature affords in plants, especially in the growth of trees, a model or a repetition of the primary form in the individual parts, the law of similarity and proportion. The entire form of the tree reappears in the branch; it even frequently appears in the form of the leaf or of the fruit. This repetition in plants results from growth, the first delicate twigs increasing to boughs and the germ becoming a complete organism. The completed building may be termed an organism. The whole grows out of a typical form and develops into numerous variations.

But another reason for a pleasing effect is based on the activity of the mind and consists in composing an image of the whole from views at different stand-points. The simpler the relation of the parts to each other, and the more frequently they are repeated, the more readily and willingly does the eye follow the lines, and the more easily is the internal intellectual image constructed. Mere similarity of form without variations and contrasts are justly found monotonous and wearisome. This requires this law to be supplemented by contrast, and contrast is to be strengthened by proportion. Contrast without harmony is disturbing and only appears irritating or even ridiculous.

82. Harmony.

The esthetic judgement of the eye is satisfied by similarity in variety. Is not the same true of the esthetic judgement of the ear? What is rhyme, on which is based the charm of modern poetry, but a similarity of sound, which cannot become identity, and which pleases even in its complications by its diversity and changes? We recognize rhyme in architecture as well. Similar rules are prescribed for harmony in music. It is everywhere a common conception and expression to designate the beautiful in sound and in form. Harmony in architecture is simply an analogy of the parts to the whole, as stated by Vitruvius. No rule of art compensates for lack of genius. Diligent use of the rhyming dictionary never made a poet; but a poet must carefully observe the rules of rhyme. Thus, knowledge of the law laid down here will never make an architect. But it will aid talent to shorten the course of experiment and to guard it from error. It may be termed a proper limit within which genius must work, in order to produce results that satisfy esthetic feeling and which may be justified to an inquiring mind.

DIVISION III. DESIGN OF THE BUILDING.

By Professor Heinrich Wagner.

83. General.

It was shown in Division I that external form must be based on internal organism of the building, that both may have the most intimate relation to each other. In the primary ideas of the design, they cannot be separated. When the artist represents his idea, he must mentally see the principal lines of the entire structure. With this general image in mind, he makes the drawing board the work shop of his mind, where he sketches in its main lines the design of the building in plan and elevation, afterwards embodying it in the completed project. The floor plans determine the form and the internal subdivision of the building; they supplement the views, elevations, and sections, which exhibit the external and internal architecture, and the construction in part. The preceding Division contains the principles controlling the design of the building, which manifest themselves in the organic arrangement and the connection of its separate parts. The points of view for considering the general design, on which is based its leading features, are now to be stated.

Chapter 1. Data for Design.

84. Programme.

The purpose and importance of the building determine the general and space requirements. These must be first considered, the number of rooms and their dimensions be fixed, and choice made of site for the building. A statement of special local needs and of personal requirements must also precede designing the structure. To these data are added limitations of money for building, frequently the mode of construction and finishing, legal and statutory requirements, etc. All such conditions are usually comprised in a programme and form the primary data of the design.

It is necessary to obtain a clear idea of all points to be considered before commencing. This can very seldom be obtained from the programme alone, which is generally defective, though the success of the work greatly depends upon this. Responsibility for the building always rests on the architect, and he recieves the blame if it be a failure. He should therefore endeavor to take part in preparing the programme. But he must obtain clear knowledge of the conditions, so that he may point out disadvantageous things and improve the requirements; he should properly guard himself from consequences to be feared. His resignation will only be tentered when the requirements of the programme cannot at all be harmonized

with a natural design for the structure. Even if the building is
merely adapted to its purpose, it must also be arranged in accordance with
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sions. The skill of the experienced architect will usually succeed in
[illegible]
sufficient to remove them entirely. These factors influencing the programme can be given only for the different kinds of buildings, and then merely according to circumstances. These requirements are as defective if too vague as for them to be too rigidly stated. The assistance of an intelligent architect is therefore indispensable in arranging the program.

83. Space Requirements.

Space requirements of the program are usually incorrectly fixed. They are often [illegible]
rent even if perfectly acquainted by experience with the needs the building is to fulfil. Persons with little knowledge of the profession may
[illegible]
ing will its faults appear; and the owner then discovers that the rooms are too large or too small, though their number and dimensions were prescribed by him, and that their sequence and arrangement do not correspond
[illegible]
es. These requirements are chiefly fixed by the purpose to be served. They further depend on the money available, assuming it to be a good and economical design. Their influence on the programme is therefore of great importance.

84. Site of Building.

Difficulties in the choice of a site are often not properly considered, even if the question of suitability for the purpose be well studied,
[illegible]
often under-estimated. The duty of an expert is to examine the proposed building site in general and in detail, and in accordance with its location, nature, area and dimensions, to consider the possibility of giving the building a fit location, of arranging it if required, or obtaining good lighting and free access of air, as well as for fulfilling other needs of the occupants for health, well-being, and comfort. These must not
[illegible]
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[illegible]
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with a rational design for the structure. Even if the building be primarily adapted to its purpose, it must also be arranged in accordance with the wishes of those who are to occupy or own it. The owner pays for the building, and therefore attention is to be paid to his wishes and decisions. The skill of the experienced architect will usually succeed in properly solving the difficulties in some manner, if his influence be not sufficient to remove them entirely. These factors influencing the programme can be given only for the different kinds of buildings, and then merely according to circumstances. These requirements are as defective if too vague as for them to be too rigidly stated. The assistance of an intelligent architect is therefore indispensable in arranging the program.

85. Space Requirements.

Space requirements of the problem are usually incorrectly fixed. They are often underrated as over estimated. The owner usually lacks judgement even if perfectly acquainted by experience with the needs the building is to fulfil. Persons with little knowledge of the profession may be able to understand a drawing, but only in using the completed building will its faults appear, and the owner then discovers that the rooms are too large or too small, though their number and dimensions were prescribed by him, and that their sequence and arrangement do not correspond to the conditions of the problem, nor to his own expectations and wishes. These requirements are chiefly fixed by the purpose to be served. They further depend on the money available, assuming it to be a good and economical design. Their influence on the programme is therefore of great importance.

86. Site of Building.

Difficulties in the choice of a site are often not properly considered, even if the question of suitability for the purpose be more easily decided than many other conditions. Yet the necessary dimensions are often under-estimated. The duty of an expert is to examine the proposed building site in general and in detail, and in accordance with its location, nature, area and dimensions, to consider the possibility of giving the building a fit location, of enlarging it if required, of obtaining good lighting and free access of air, as well as for fulfilling other needs of the occupants for health, well-being, and comfort. These questions are often of such importance that they decide the choice of site. But for other buildings, the point of view may be of an esthetic nature, requiring from the artistic stand-point that the external architecture may produce a striking, graceful or monumental effect.

Other questions are not technical, concern the suitability of the building, but are only indicated here. First are convenient roads for access to the grounds, connection with streets and waterways, and secondly is the opening of the building to business, to the life and traffic of a great city, making it of as easy access as possible, and thirdly, to separate it far from noise and manufactories, from bustle and disturbances of all kinds.

87. Local Influences.

First is an examination of the site in reference to its nature, low or high situation, existence of water in the ground and possibility of inundation, which will decide the grade for the building or its lower story, and other precautions to be taken against water and dampness, and the means to be adopted for drainage. Lack of water must often be remedied. In low ground one must beware of marshy earth, of fog and stagnant air, while on hills and on the sea shore, the effects of prevailing winds must be guarded against. The possibility of a sinking of the earth and of earthquakes must also be considered.

88. Place and Apect of Building.

Location and aspect of the structure partly depend on these, partly on the outlook and surroundings, as well as on orientation for the building or some of its parts. This point will be fully treated for certain kinds of buildings, but is here mentioned in general. An eastern or southeastern outlook is most favorable, just as western and southwestern exposures are unsuitable. To directly southern outlook, although generally healthy, it is objected that during summer one must suffer from heat of the sun, while directly northern exposure is to be avoided for lack of sunshine, though sometimes desirable. The nature and form of the site, course of streets and adjacent buildings, and other local conditions usually prevent the location of the building as otherwise preferable. Even where one has a free hand, it would often be best to take into account various preferences and considerations by not facing the building exactly to the chief points of the compass, but making such deviation as to make climatic influences less prominent.

89. ARtistic Treatment.

The degree of artistic treatment to be given to external appearance and to internal finish of the building depends on its purpose and rank, then upon the many at command. For the first, the principles of treatment in Division I must direct and guide. Consideration of what is most suitable and effective for works of monumental architecture, for ecclesiastical or secular purposes, or for merely useful buiodings for public or private

[illegible]

buildings, is generally preferable, and it was already stated in Division I that skillful use of this building material and a truthful treatment of it produces a better and more beautiful effect than a more lavish expen- [illegible] even where funds are amply provided, and where one has the good fortune to be entrusted with a work of monumental architecture, it would be well [illegible] ness must be paired with simplicity, light with shade, animation with repose, and that where the heart rejoices must be not magnificence, but har- [illegible]

50. Fixing cost of building.

The chief factors that fix expenditure are the volume of space required [illegible] and afterwards in the estimate of cost. In order to first compute the sum required for the building, buildings of similar size and execution, recently erected under like circumstances, may be taken as a basis; and assuming equal heights from these may be deduced the unit of cost per square foot of ground area of the building, or the cost of a building of one, two or more stories, or more correctly, the cost per cubic foot of the [illegible] passages, stairways, etc., that should be made the basis of the unit [illegible] in cost per square or cubic foot of useful space to occur, according to [illegible]

purposes, must be left to the judgement and imagination of the architect. Directions of this kind, afterwards usually included in the programme, may be stated only in a very general way with reference to money available, and serve as an approximate limit for the amount of artistic treatment. That design will be best, which produces most with the smallest cost.

If available funds are limited, one shall not cramp the space of the building, but rather limit architectural treatment by avoiding everything unusual. Customary local ideas are almost invariably cheapest. Therefore the building material in the vicinity, so far as suitable for the building, is generally preferable, and it was already stated in Division I that skilful use of this building material and a truthful treatment of it produces a better and more beautiful effect than a more lavish expenditure of costly material without real artistic knowledge. Therefore, even where funds are amply provided, and where one has the good fortune to be intrusted with a work of monumental architecture, it would be well to exercise wise moderation and to be mindful of the principle, that richness must be joined with simplicity, light with shade, animation with repose, and that where the heart rejoices must be not magnificence, but harmony.

90. Fixing Cost of Building.

The chief factors that fix expenditure are the volume of space required and the degree of artistic treatment. These appear clearly in the design and afterwards in the estimate of cost. In order to first compute the sum required for the building, buildings of similar kind and execution, recently erected under like circumstances, may be taken as a basis, and assuming equal heights from these may be deduced the unit of cost per square foot of ground area of the building, or the cost of a building of one, two or more stories; or more correctly, the cost per cubic foot of the total volume of the building may be similarly found. It is not so much the ground area covered by the building, but rather the area that may be utilized for the special purpose of the building, after deducting walls, passages, stairways, etc., that should be made the basis of the unit price for comparing the cost of buildings. This comparison has been made for buildings of the same kind and we find a very considerable difference in cost per square or cubic foot of useful space to occur, according to whether the arrangement of plan of the building is more or less good and compact, independently of other conditions affecting the cost.

But it should not be understood that dimensions of important and necessary ante rooms and corridors or thickness of walls should be reduced;

the facade and be increased in many kinds of ground plan for buildings [illegible] in the building, [illegible] producing the effect of space, to be attained by their simple and satisfying arrangement. This aim gradually causes greater extension of the facade and frequently projecting architectural masses which increase the cost. The increase here mentioned is often greater [illegible] in form and richer architectural subdivision of the structure. Much ado is made about the latter, because external and therefore visible to everyone. Nothing is said of waste in arrangement and connection of rooms and of parts of the building, this defect being connected with the inner organism and therefore not apparent. These points will be considered by basing cost of the building on the unit of useful space as indicated. The same end may be easily attained in many cases by computing the unit price according to number of persons accommodated in the building, as in churches, schools, hospitals, etc., by computing the cost per sitting, per bed, etc. This method may also be employed for other units of use.

31. Limitation of Cost.

[illegible] statement of cost of the building, [illegible] after the design has been completed. Nothing has so often brought the architectural profession [illegible] with the public [illegible] the estimated cost of the building. This has produced the result that [illegible] contractors, sometimes [illegible] at fixed prices. [illegible] that he will [illegible] and the constructor changes his views, and permits changes from the original plans, or selects a kind of building, he allows enlargements, better construction, or greater richness of external or internal architecture, then had been expected. When he comes to payment and final settlement, he is dissatisfied, and all blame is thrown upon the architect. [illegible] want an good [illegible] reproach for exceeding cost and free damages [illegible] by repeatedly and in writing notifying the owner [illegible]

[illegible] that estimates. [illegible] its [illegible]

the former are so increased in many forms of ground plans for buildings as to inconvenience communication in the building, without producing the effect of space, to be attained by their simple and centralized arrangement. This also gradually causes greater extension of the facade and frequently projecting architectural masses which increase the cost. The increase here mentioned is often greater than that for better development in form and richer architectural subdivision of the structure. Much ado is made about the latter, because external and therefore visible to everyone. Nothing is said of waste in arrangement and connection of rooms and of parts of the building, this defect being connected with the inner organism and therefore not apparent. These points will be considered by basing cost of the building on the unit of useful space as indicated. The same end may be simply attained in many cases by computing the unit price according to number of persons accommodated in the building, as in churches, schools, hospitals, etc., by computing the cost per sitting, per bed, etc. This method may also be employed for other units of use.

91. Calculation of Cost.

But a more accurate statement of cost of the building, with a possibility of increase or reduction, is by the careful calculation of cost after the design has been completed. Nothing has so often brought the architectural profession into such discredit with the public as exceeding the estimated cost of the building. This has produced the result that architectrual works usually taken from the architect and transferred to contractors, sometimes for a lump sum, or by measurement at fixed prices. The owner believes that the cost of preparing the design will be saved, that of supervision by the architect during erection, and that he will also have security against any excess in cost. Yet this is generally caused by the owner himself, either because he forms correct ideas only during the construction, changes his views, and permits changes from the original plans; or seized by a love of building, he allows enlargements, better construction, or greater richness of external or internal architecture, than had been expected. When he comes to payment and final settlement, he is dissatisfied, and all blame is thrown upon the architect. The latter should therefore be careful, when changes are made, to protect himself in good time against reproach for exceeding cost and from damages for his responsibility, by repeatedly and in writing notifying the owner of the additional cost for these changes from the original design.

The architectural profession in Germany here finds itself in a more difficult position than in other countries. Nowhere else are its duties so onerous or the demands of its responsibility so great, and yet nowhere

the work to the contractor?

[illegible]

own hands. It is certainly true that the confidential relation then [illegible]

[illegible]

[illegible] of the estimate of the cost as is the case in England the part-
[illegible]
[illegible], the last being prepared by the builder; [illegible]
formed in France by the architect [illegible] and the [illegible]
[illegible] and for [illegible] In England, [illegible]
accurate description of the work is added to the plans and prepared by
the architect, who has to see that this is [illegible]
[illegible]
services are exclusively devoted to his employer. The functions of the
contractor and of the architect are not united, being considered incom-
patible with the authority of the architect. Interest in any building
contract is condemned in the strongest manner [illegible]
[illegible], and preparation of the quantities by the architect or his
partners is objected to, at least in France.

No proposal now exists in France, that we may obtain to the [illegible]
position of our English colleagues. But they are just as strictly held
to their specifications and to the contract, as we are to our estimate
of cost. Variations from drawings are never to be entirely avoided, for
[illegible]
things occur; improvements are suggested not to be rejected without [illegible]

else is its position so uncertain, its influence so limited. This is partly due to two things, connected with the usual method of estimating and contracting:-

1. The German architect is generally required to compute the quantities and the estimate of cost of the building, required before letting the work to the contractor.

2. The architect and contractor are usually the same person, an academically trained architect becoming a contractor, or an artistically gifted contractor being also a practicing architect.

The first case may have results of a most serious kind, as shown by cases in which architects have become actually liable by exceeding their preliminary estimates. If the custom is once established for the architect to prepare the estimate of the cost, a moral duty is laid on him to keep within it, and he must lessen the risk by taking the execution into his own hands. It is certainly true that the confidential relation then ends, which the architect should have as professional agent of the owner, and for the good of the entire profession this is most strongly to be deplored.

The position of the architect becomes perfectly clear and independent, and his authority greater and more important, if he does prepare the quantities and the estimate of the cost as is the case in England and partly in France. In England the first is made by the architectural surveyor, the last being prepared by the builder; similar functions being performed in France by the architecte-verificateur and the entrepreneur. As their basis and for letting the contract, in England, a specification or accurate description of the work is added to the plans and prepared by the architect, who has to see that this is strictly carried out during his supervision of the work. His duties are otherwise the same, but his services are exclusively devoted to his employer. The functions of the contractor and of the architect are not united, being considered incompatible with the authority of the architect. Interest in any building contract is condemned in the strongest manner by the entire architectural profession, and preparation of the quantities by the architect or his partners is objected to, at least in cities.

No prospect now exists in Germany, that we may attain to the fortunate position of our English colleagues. Yet they are just as strictly held to their specifications and to the contract, as we are to our estimate of cost. Variations from drawings are never to be entirely avoided; for in new buildings, and even more in alterations of buildings, unforeseen things occur; improvements are suggested, not to be rejected without de-

triment, and every such change causes an increase of cost. It is therefore advisable to suggest to the owner to reserve a certain amount therefor, about ten per cent of the cost of the building, independent of any addition to the estimate.

Within limits fixed in this way, it is possible to keep within the estimated cost, exceptigg under very unusual conditions. Even with the present system of estimating, this will result in assuring to the architectural profession its just claim to make the design and supervise the construction, but will also furnish a systematio and fixed basis for its natural position as confidential agent of the owner. Its importance in the state and community would thereby be increased, and its independence become indisputable. The owner would recognize that he would always do better to entrust his building to a skilful and experienced architect, than to transfer it to the master builder. He would understand that the work would thereby gain in design and artistic treatment and in execution, by the architect's supervision of the materials and workmanship, as well as security against claims for extras. These advantages and the security of the owner, who knows that his interests are assured, abundantly compensate for commission paid to the architect.

Chapter 2. Treatment of Rooms.

92. General.

To produce an enclosed room is generally the aim in erecting a building. We therefore commence with the single room as the simplest form of the building. This is also to be regarded as the cell of the architectural organism, as the element which forms a basis for the shape of the building. The use of the room and of the building are not here considered, but only its architectural form, as it appears in the design. The room is partly formed by space-enclosing and partly by space-dividing structural parts. The space-enclosing parts are the roof and the external walls, the space-dividing parts being the floor and ceiling, the division and middle walls, the latter usually parallel to the principal external wall, to which the former are generally perpendicular. Floors and ceilings subdivide the building into different stories.

This frequently requires a space to be merely enclosed, or sometimes covered, otherwise being as open as possible; sometimes a hall must be of such extent that ceiling and roof require intermediate supports between its walls, such as isolated pillars, piers or columns. Colonnades or arcades are also employed to sundivide space. The ceiling, roof, and walls are seldom unbroken; for a connection with the exterior or with rooms above or below, openings are arranged, generally so that they can be clos-

ed as desired. We have to treat of these parts of the building only so fat as upon their respective places and locations may depend the treatment of the space and the treatment of the building.

a. The Room.

93. Its General Form.

In the treatment of the room, we have first to consider its form in general, with reference to factors influencing this, and whether it is to be considered as an isolated or a space-forming element of the building. This form primarily depends on the intended use of the room, then on the possibility of easily combining it with rooms of similar form with due regard to shape of the building, and lastly upon the money available and on the results of its shape.

94. The Elementary Form.

The rectangular form possesses most advantages in all respects. Regarded from a purely mathematical standpoint, the circle among all figures, and the square among all rectangular figures, are those most compact, or those requiring least wall surface to enclose a given area. This advantage is only theoretical, since disadvantages generally result and neutralize it. The perimeter of the circle is about 11 per cent less than that of the square, therefore materially less. But circular rooms cannot be directly connected. The construction and the details of windows and doors are less simple; all furniture and furnishing must be made to order at increased cost. With a alrge radius, these difficulties are lessened or or removed by the slight curvature, but with a small radius, they are increased and the circular type of plan is exceptional for small rooms. The approximate form of a regular polygon also has many difficulties in combination and construction on account of numerous angles and deflections.

The rectangle makes everything more simple and natural in construction and arrangement; it is therefore the usual and preferred elementary form of a room as a building unit or separate element of the building. (Fig. 93). Oblique angled rooms cannot be avoided when the site is of irregular form, and if variation from the rectangle be not great, it then becomes scarcely noticeable (Fig. 94). It sometimes occurs that even with rectangular ground plan, as on sites at angles of streets, it is permissible to arrange the plan about an axis oblique to the external walls, changing a rectangular room into one partially oblique (Fig. 95). To transform a slightly oblique room into a rectangular one, if the irregularity must not appear, the solution in Figs. 96 and 97 may serve; but such arrangements are not applicable to ordinary plans on account of the considerable expense thereby incurred. If the variation from the right angle

be considerable, the obliquity is to be limited as far as possible to subordinate rooms, or by interposing suitable forms, a regular and pleasing treatment may be obtained (Figs. 98 to 101).

It is still to be considered, when the square is to be preferred to the rectangle. Economy of wall surface will not decide, for if the rectangle does not differ very much from a square, the saving will be slight, scarcely 1 per cent difference for a rectangle having proportions of 3 to 4.

Therefore difficulties in the design of the ground plan are not created, where advantages do not result, everything being taken into consideration. The square form will be preferred, for a tower, (Fig. 102), where no reason exists for giving to room different dimensions on transverse and on principal axes, but suggesting the same treatment in both directions. Figs. 103, 104 are examples. In these and many other cases, the regular polygon or circle is preferred, or ground forms composed of portions of these figures, whether intended for special purposes, as for audience rooms of theatres, circus buildings, etc., for a centrally located room, or for one emphasized in some other way on the plan, or for convenient use of an acute or obtuse angle, an angular and unsymmetrical portion of the plan is actually preferable. The elliptical form is exceptionally found and may be replaced by an approximate figure composed of arcs of circles, or of one extended by straight lines.

The arrangements first described are represented in Figs. 105 to 109. by Figs. 105 and 106 an idea of the external appearance will easily be formed, creating a conviction that by solutions derived from the most important conditions of the problem, a characteristic effect may be obtained, a transition pleasing to the eye, and a combination of the masses of the building and of the members, which would otherwise be awkwardly connected together. Figs. 107 to 109 exhibit rooms enclosed by arcs of circles.

95. Extension of Rooms.

For extension of rooms or annexes, apses, galleries, exedra, angle bays, balconies, loggias, porticoes, grottoes, etc., which must be considered as accessories and always have a special purpose, another type of form is quite appropriate, as in Figs. 110 to 117, whose effect is increased by contrast with the ordinary form. But for simple and frequently repeated rooms, the use of unusual forms is unjustifiable. These should not owe their origin to mere whim or a desire of notoriety. Therefore the fanciful ground forms so commonly employed in the last century (amusement buildings, villas, etc.) should not be imitated, however skilfully they may be combined.

96. Forms of Ceiling.

The form of ceiling depends on its treatment, and the following cases are especially to be distinguished.

1. The roof at the same time forms the ceiling of the rooms; it is then space-enclosing or may be space-dividing, when an upper room exists.

2. The ceiling extends free over the entire room, or intermediate supports may be arranged between the walls.

To these two motives, and the method of construction connected therewith, are to be referred the most varied forms of ceilings, which partly assume plane or curved forms, are partly inclined with uniform or broken slope, or partly of simple or compound form. It is unnecessary to discuss then further, sincethey seldom occur except in rooms of especial importance. (Div. 5). For ordinary rooms or simple elements of the building, the horizontal form of ceiling is most natural. It will therefore be taken as a basis, and the rectangular form of room be fixed upon as the leading one, both in section and in plan. The dimensions of the room, its length, depth, and height, are first determined in accordance with the purpose and importance of the building, afterwards according to its construction and the location of windows, doors, etc., opening out of the room.

97. Length: Distance between axes of Windows.

The length of the room is fixed in accordance with the number of windows to be placed in the external wall and according to distances between their vertical axes. The latter varies with the scale assigned to the building. The more important the structure, the greater is the distance between these axes. Buildings for utility or simple dwellings, especially buildings with small rooms and numerous division walls, naturally have small distances between these axes, while monumental structures frequently have very great distances between them. From 6.26 to 8.20 ft. may be given as least distance between axes of windows, 8.20 to 11.48 ft. an average, and 22.96 to 26.24 ft. being the greatest. The distance between axes indeed very seldom falls outside these limits, it not being advisable to assume a greater scale for the building and a greater distance between axes of the windows than the purpose of the building would justify. The lighting of the room would sometimes be injured thereby. But it would certainly be very bad to make distances between windows too small, for the necessary repose in the internal and external appearance of the building would be lacking; the subdivisions would be too small, the relief too weak, and the general effect not imposing. The given average distance of 8.20 to 11. 47 ft. will therefore be exceeded in important private residences, and especially in many public buildings, on account of their purpose. (See Table).

[illegible] groups close together, it is then [illegible]
rooms, thereby obtaining large axial distances and more imposing effects.

[illegible] is the place for the position of the division wall, which need not [illegible]

front on one side of the staircase more is often necessary). (Fig. [illegible]

(b). Depth; Position of Doors.

The depth is the most important dimension of the room; other dimensions are to be chiefly fixed according to the [illegible], and in designing the building, we [illegible] purpose with the depth of the room depending on the [illegible] ceiling or roof beams. The depth itself depends on the possibility of [illegible] lighting by day. If the building [illegible] from the [illegible] walls, piers or columns, isolated columns, division walls, etc., [illegible] at such distances as to require no support between them, then any depth [illegible] taken at pleasure, provided that sufficient natural lighting is also obtained. In large rooms [illegible] depth [illegible], one of the [illegible] and method of construction must be arranged to secure the required depth.

For rooms of unusual size, the simplest construction is to arrange the ceiling so as to be free between the walls; it generally rests on the external and middle walls, and the depth of the room is then [illegible] limited. Even with iron beams, the depth can scarcely be more than 20.0 to 23.0 ft. without using girders, or seldom over 21.3 to 23.0 ft. [illegible] This is sufficient for most purposes, less depth frequently sufficient, and only in buildings with large rooms will more be required. The [illegible] secure sufficient clear length of the room, if the lighting [illegible] along its longer sides.

But the depth is primarily fixed by the use of the room, which demands [illegible] wall surfaces of a certain length. Therefore, if economy requires the least possible depth of room, we may decide on the possibility of [illegible] the connecting doors of the rooms in the division walls, that the required wall surface exists at both sides. For most purposes [illegible] sufficient, hence the door from [illegible] to [illegible] feet remain to receive larger furniture, when from [illegible] ft. at the other for smaller pieces [illegible]

But if definite reasons permit the arrangement of windows and other openings close together, it is then advisable to combine them in pairs or groups, thereby obtaining large axial distances and more imposing effect. Whether the room has one, two, or more windows in front, depends on whether its average length is one, two or more times the axial distance between windows, less the thickness of division wall. The pier between the windows is the place for the location of the division wall, which need not be exactly at the centre of the pier. Less than the half is often sufficient at one side of the window and more is often necessary. (Figs. 118 to 120.).

98. Depth: Position of Doors.

The depth is the most important dimension of the room; other dimensions are to be arranged in accordance therewith, and in designing the building, we therefore commence with the depth of the room, selecting the form of ceiling to suit this. The depth itself depends on the possibility of good lighting by day. If the ceiling be suspended from the framework of the roof, or rests on girders, isolated columns, division walls, etc., spaced at such distances as to require no support between them, then may depth be taken at pleasure, provided that sufficient natural lighting is also obtained. In rooms of unusual depth (Div.5, Chap.4), one of the indicated methods of construction must be employed to secure the required depth; but for rooms of unusual size, the simplest construction is to arrange the ceiling so as to be free between the walls. It generally rests on the external and middle walls, and the depth of the room is then naturally limited. Even with iron beams, the depth can scarcely be made more than 24.6 to 26.2 ft. without using girders, or seldom over 21.3 to 23.0 ft. with wooden beams, generally having an average depth of 16.4 to 19.7 ft. This is sufficient for ost purposes; less depth frequently suffices, and only in buildings with large rooms will more be required. The latter require sufficient clear height of the room, if the lighting only occurs along its longer side.

But the depth is primarily fixed by the use of the room, which demands available wall surfaces of a certain length. Therefore, if economy requires the least possible depth of room, we may decide on the possibility of so placing the connecting doors of the rooms in the division walls, that the required wall surface exists at both sides. For most purposes it is sufficient, beside the door from 6.56 to 6.89 feet remain to recieve larger furniture, with from 3.28 to 3.61 ft. at the other for smaller pieces. According to whether a single or double door is employed, for which with architrave from 4.26 to 5.90 ft. is to be allowed, there results a depth

or 14.75 ft. as in Fig. 118, or 16.40 ft. as in Fig. 119. Whether the door is set near front or rear wall depends on which portion of the division wall is to be best lighted in the day time. Custom influences this, but if the door is set in the middle of the wall, as in Fig. 120, a depth of 18.00 to 19.70 ft. is required. The arrangement of heating apparatus is important for the wall surfaces. The preceding figures are based on given average dimensions. Yet they permit reduction if necessary. The depth is but rarely fixed for a single room, since a series of rooms generally have the same average depth.

99. Height: Arrangement of Windows.

This is true for the ehight of the room, since the stories extend through horizontally, a break in this arrangement being only occasionally found. Height of stories has remained constant for centuries in buildings of the same kind, and may within certain limits be considered as fixed. Like dimensions of rooms, the doors, windows, etc., are in detail fixed by the height of man, otherwise by the mode of use. Heights of stories of ordinary buildings are seldom less than 8.20 to 9.84 ft. or more than 11.48 to 13.10 ft. But for buildings of munumental character, the lower or upper limits may scarcely be given; yet heights of 19.70 to 26.20 ft. are not at all unusual in places. (See Table)

But buildings for purposes of mere utility frequently require heights exceeding the usual ones. For their dimensions, one must chiefly judge by size of room, especially by its depth, and it must be made higher, the deeper it is, so that parts most distant from windows may be well lighted; this will be more effective, the higher the top of window, whether window sill be somewhat higher or lower; for the latter is only decided by the use of the space next to the window. Therefore in deep rooms to be well lighted, the window should extend as close to the ceiling as possible (Fig. 121). This causes difficulty if the beams are perpendicular to the front wall. Such high locations for windows also appear inadvisable for most buildings; some wall space is required above lintel or top of window opening to recieve curtains, blinds, etc., for reducing the light. This produces the usual arrangement in Fig. 122.

It is permissible in case of necessity to break the levels of the stories on account of certain rooms, which must have greater height. This may be done in either of three ways:

1. By dropping the floor, the room then usually being in the ground story or above subordinate rooms (Fig. 123).

2. By raising the ceiling, above which the roof is directly placed, so that the height of the roof can be entirely or partly utilized. (Fig.

f 124).

3. By extending the room through two stories, whose total height is required. (Fig. 125).

It must always be remembered, that these arrangements must not make the construction much more difficult, mor may passage within the building be impeded.

100. Proportions.

In determining the height of such unusual rooms, a factor of importance in esthetic relations is to be considered, which may be neglected for rooms ,f ordinary dimensions arranged in continuous stories. This comprises proportion of its interior, or the ratio of its dimensions. For determining these, the point of view of the observer in the room itself is decisive, even more than for the exterior. The following data may serve as approximate rules, where length and depth are to be taken between the points of support of the ceiling, and height is measured between floor and ceiling.

According to old and well known rules:-

1. Height = 2/3 to 3/4 the depth.
2. Height = 1/3 (length + depth)
3. Height = 1/2 (diagonal of rectangle of length and depth).

According to Durand:-

4. For horizontal ceilings:-
   Height = depth, if length exceeds depth.
   Height less than depth for square, polygonal or circular rooms.
5. For vaulted ceilings:-
   Height = /1/2 times depth, if length exceeds depth.
   Height = depth for square, polygonal or circular rooms.

But these rules will be so modified for rooms of unusual size that the height may be so much less than the depth, the greater the absolute dimensions.

According to Fergusson:-

6. Height = 1/2 depth + square root of length.

The first rule makes the height depend upon the depth and is very arbitrary; rules 2, 3, 4, and 5 are frequently inapplicable. In the last two, Durand has correctly recognized that the height of the room is not alone to be brought into relation with its length and depth, but also into harmony with the form of the floor and ceiling. Yet he proceeds arbitrarily, when he makes the height of the room equal to its depth, or to one and half times the depth. Fergusson's rule gives rather inadequate height for small rooms with length and breadth less than 16.4 ft., but very suit-

able height for large rooms. If several large rooms occur in a story, a suitable average height is to be assumed. When these are of sufficient importance, subordinate smaller rooms may be arranged in two stories by inserting an intermediate floor.

Dimensions of rooms are also determined in accordance with space required for their purpose, generally being calculated for the number of persons assumed therein. These details are referred to the discussion of the different kinds of buildings, and for the usual dimensions of doors, windows, etc., see Part III of this Handbuch. A collection is added of axial distances, depths and heights of rooms, taken from a number of the most important buildings, mostly recent. The absolute dimensions are in many cases fixed by the uses of the room, but in other cases are influenced by the rank and importance ofthe building. As an example of the earlier period for comparison only, is added the Loggia dei Lanzi at Florence, built about the middle of 14th century, which is perhaps unsurpassed in beauty and grandeur of proportions.

TABLE OF BUILDINGS.

A. = distance between vertical axes of windows in feet.

D. = Depth of room in feet.

H. = clear height of story in feet.

Kind of Building.	A.	D.	H. 1st.	H. 2nd.	Notes.
School, Munich	5.25	26.1	12.5	13.5	5 lg. windows per room. dble. seats.
Farm buildings, Frankfurt	5.90	12.5	8.2	----	A. = width of stall
Res. of H. Fischer, Vienna,	6.56	19.7	12.5	13.8	3 W-ws combined.
Res. of H. Wahner, Aix-la-Ch.	7.55	20.1	14.6	11.7	
Prison, Plotz. Berlin	8.20	13.1	10.8	10.8	A. = width of cell
Central Hotel, Berlin	9.35	19.7	17.4	14.0	Front, Fiedrich St.
Assem. Bldg., Neustadt	9.86	29.5	19.7		A. = unit of bldg.
Post Office, Stettin.	9.86	19.7	15.4	15.4	Simple & richer windows alternate at 2 A
Verein Bank, Stuttgardt.	9.86	20.4	14.1	15.4	Simple & richer windows alternate at 2 A
Building School, "	11.0	23.3	14.4	14.4	A. to 2 Drg. Tables.
Frank. Hotel, Frankft.	11.20	24.2	19.7	13.2	Central portion.
Main Bldg., Univ. Strasburg.	11.20	46.6	19.4	31.8	Ent. hall & main hall.
Court House, Stuttgardt,	11.30	21.5	16.4	15.2	Main front.
Theatre, Riga.	11.50	29.9	13.8	18.4	Ent. hall & foyer.
Polytech., Berlin, M. Bldg.	11.80	27.9	19.6	20.5	A. = 10 small or 8 large seats.
Stad. Art. Inst., Frankfort	12.30	14.8	19.7	16.4	A. = width of rooms.

Name of Building.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] & Market [illegible], Budapest	17.40	29.0	11.2		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible], Berlin	16.00	[illegible]	17.4	21.4	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible], Berlin	16.85	25.0		10.7	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	16.8	[illegible]	2.6	11.0	[illegible]
[illegible]	[illegible]	[illegible]			[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible], Vienna	19.6	[illegible]	[illegible]	40.0	[illegible]
State Library, Stuttgart	17.5	[illegible]	18.4	[illegible]	[illegible]
[illegible] Block, Berlin	10.[illegible]	[illegible]	75.1	10.4	[illegible]
[illegible] School, Frankfort	12.[illegible]	46.1	17.1	22.2	[illegible]
[illegible] Gymnasium, Berlin	27.0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible], Berlin	[illegible]	[illegible]		[illegible]	[illegible]
[illegible], Vienna	21.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Polytechnic, Zurich	23.6	[illegible]	24.4	10.8	[illegible]
[illegible], Berlin	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible], Vienna	30.5	[illegible]	[illegible]	15.6	[illegible]
Loggia d'Lanzi, Florence	38.5	46.2		72.7	Total [illegible]

b. Lighting of Rooms.

101. Natural Lighting.

Natural lighting by sun light will be treated here, and is introduced through openings in the walls, ceiling, or roof. These either open di-

Kind of Building.	A.	D.	H. 1st.	H. 2nd.	Notes.
Chem. Inst., Univ. Vienna	12.50	23.0	17.8	19.7	A.=2 working plcs.
Rathans, Vienna	12.50	25.0	14.5	23.6	A.=unit of bldg.
Govt. Bldg., Dantzic	13.15	21.0	16.1	31.2	Central Building.
Abatt. & Market Budapesth	13.40	25.0	11.2	----	A.=4stalls.
Library, Univ. Of Halle	13.80	26.0	14.1	14.1	A.=2book stacks, 2 tiers to story.
Gen. Hospital, Berlin	14.00	29.9	17.4	21.4	A.=2 beds.
Anhalt R.R. Sta., Berlin	14.40	44.3	----	29.5	Waiting room.
Harmonic Society, Heilbrau	14.80	18.1	14.8	18.4	
Vict. Storehouse, Berlin	15.30	60.8	9.2	8.9	
Royal Villa, Berg.	15.80	25.0	19.7		N. front.
Castle Hummelshain, Jena.	16.4	32.8	16.4		Main front
Meininger Bauk., Berlin	16.6	18.4	15.6	16.1	Double windows.
Barracks, Lubec.	16.8	30.5	11.0	11.0	A.=room for 10 men.
Abattoir, Berlin	17.1	30.8	20.7	----	A.=1 place.
Theatre, Berlin.	17.2	45.4	15.4	44.3	Concert hall 2 story.
Bourse, Vienna	17.8	36.7	29.5	46.0	Ent. hall & hall on main front.
State Library, Stuttgardt.	17.8	59.0	16.4	32.5	A.= 2bookcases; 4 tiers in up. story.
Spinn Block, Berlin	18.4	18.7	15.1	14.4	For 1st & 2nd stories.
Wohler School, Frankfort	19.7	36.1	17.1	32.8	Grouped windows aby. Ent, hall & main hall.
K.W. Gymnasium, Berlin	20.0	30.5	14.4	14.4	A. = 1 schoolroom with double window.
Borsig Palace, Berlin.	20.4	20.7	23.3		Voss St. front.
Res. Thonet, Vienna.	21.4	39.4	16.4	14.4	1st & basement stories together: A.= 2 windows in 2nd story.
Polytechnikum, Zurich.	23.6	36.1'	26.6	29.5	Central portion;- A. = 2 windows in basement.
Pal. Reichstag, Berlin	26.8	42.7	21.4	38.5	Main facade, centre.
Art. Ind. Museum, Berlin	27.8	26.3	20.7	24.0	Grouped windows.
Main 4.4. St. Frankfort	29.9	180.0	78.8		Central Building.
Museum, Arsenal, Vienna	35.5	39.4	24.3	38.5	A. = 1 stand of arms.
Loggia d'Lanzi, Florence	38.5	35.8	76.7		Total height.

b. Lighting of Rooms.

101. Natural Lighting.

Natural Lighting by sun light will be treated here, and is introduced through openings in the walls, ceiling, or roof. These either open di-

rectly into the open air or into a well lighted room above or at one side. Direct light is obtained in the first case, borrowed in the others. Still dspecially in side light, a distinction must be made between that from the entirely unlimited exterior and that from a limited space , streets or courts, enclosed by adjacent buildings, light then being partly reflected. These openings are also means of ventilation, which then occurs in the most rapid and natural manner; j in our climate they seldom remain open, but are mostly closed by sash windows, or by glazed skylights in ceilings or roofs. Glazed doors also sometimes light a room. It is only necessary to mention these arrangements, so far as their location in wall or ceiling and the required area of light surface for the room are concerned. Quality of light depends upon the mode ,f lighting:-

1. Whether low or high side light or ceiling light is provided.
2. 2hether this is direct or borrowed, side or ceiling light.

The climate, season of year, location and surroundings, also influence intensity of light.

102. Glass Area.

In determining the glass area, these factors are to be considered; the use of the room is of great importance, and it is to be remembered that intensity of light diminishes inversely as the square of the distance increases. Since light is broken and diminished by glass, the window is to be considered as a source of light, and the distance is to be taken from it. All these are to be taken into account in given cases, and the light area determined accordingly. Requirements based on the use of the room will be mentioned in successive volumes of this Handbuch under different kinds of buildings, such as school houses, exhibition buildings, museums, etc. Reliable methdds for determining quantity of light introduced through windows into any given room, will be given in other volumes of this Handbuch. These processes chiefly consist by means of solid angle measurer, in measuring the pyramid of light directly radiated to any point in the room to be examined.

The general rules are unsafe and inaccurate, such as that for lighting rooms of ordinary height, 1/7 to 1/5 of the floor area is to be taken as the glass area, and that the top of the window must be at a height above floor equal 2/3 the depth of room, etc. For openings may thereby be fixed, which may sometimes introduce insufficient light, or may supply more light than is necessary. The latter results much more frequently than the former, using the ratio of 1/7 to 1/5, and a window opening fixed by this rule often produces such abundant lighting of the room, that this light must be at times obscured by curtains, shutters, etc. This is true for

both side lights and skylights; if the former are more frequently limited by surroundings than the latter, then is the light from the latter so much the less intense, being usually recieved through the roof, at a greater distance from the floor, generally through two thisknesses of glass. Reflected light is especially unsuitable and disturbing and should therefore be avoided.

103. Direct and Indirect Lighting.

Only rooms recieving direct light can usually be said to be well lighted. Windows are used for this purpose, and their lintels or tops are placed as high as possible, according to Art. 99. The rectangular window is most suitable, admitting more light than any other form of equal width and height. Height of sill window is fixed according to use of the room. The usual height of 2.48 to 2.62 ft. is especially applicable to living rooms, and is such that one can conveniently open the window and look out. In many cases (schools, prisons, etc.) both of these are not intended, but merely to light the room, and such a low sill would not be advisable. The sill is then higher, in many cases above the head as in halls, to afford protection from draughts through crevices of windows. (Fig. 130). Borrowed light should be employed only in subordinate rooms and when unavoidable, but only with care and so as to make ventilation by the openings possible. Therefore windows should be arranged in addition to skylights, or at least air flues should be provided.

104. High Side Light and Ceiling Light.

High side light expecially occurs in rooms of great depth, and in those of such great height that windows are placed above roofs of adjoining rooms (Fig. 126). Notable examples of these are domed structures and basilican designs (Figs. 127,129). Rooms of very great depth require for good lighting windows along both long sides as well as along the ends. Yet one should avoid placing windows where unnecessary. Ceiling light is frequently arranged, though improperly, with entire exclusion of side light. Both often influence the form of the ceiling (Figs. 128,130). Direct ceiling light can only be obtained in a room located in the upper story; yet it may also sometimes be utilized in lower rooms, as in Fig. 128.
The value of ceiling light in comparison with that of high side light is explained by Boileau in Figs. 131, 132. These illustrations exhibit both modes of lighting arranged in the same room, for example, in a hall 32.8 ft. wide with side rooms 18ft, wide extending along the long sides, with two stories of galleries above. These side rooms recieve light only from the opening in the ceiling, or from side openings in upper wall of hall. For points O, L, I, F, of the floor, the number of light rays falling on

each are found for a cross section plane through the central angle in both cases. These give the following results.

	Fig. 131.	Fig. 132.
For point F	47 degrees.	13 1/2 (9 + 4 1/2) degrees.
" I	42 "	11 1/2 (11 + 1/2) "
" L	26 "	10 1/2 degrees.
" O	9 1/2"	9 1/2 "
" B	0 "	0 "

If these values are laid off as ordinates on the axis of abscissas, B, O, L, I, F, the areas of the hatched surfaces given in the two illustrations represent the relative quantity of light, which for an assumed distance of 6.56 ft. between the points, are in the proportion of 202 in Fig. 131 to 76.5 in Fig. 132. The number of light rays be similarly determined for points in the two galleries. The length of light openings is neglected in both cases. For complete comparison, this must be taken into account, i.e. there must not alone be measured a section plane through the opening for light, but the volume of the entire pyramid of rays, whose base is the light opening, and whose vertex is the given point, as well as the inclination of the resultant of the light rays. This may be done with the solid-angle-measurer already mentioned.

The light reflected from all sides will be introduced into those parts of the room that recieve no direct light (vertically hatched in Figs. 131, 132). It is to be ascribed to this, that high side light and omission of ceiling light as in Fig. 132 affords a light less bright, but much milder and more uniform than ceiling light, which has a very dazzling and disturbing effect. Fig. 132 is an example taken from a Vienna building with the arrangement in Fig. 131. A kind of high side light and very effective is afforded by saw-tooth or shed roofs. The glass area should then be turned to the north.

The lighting of rooms located in the intersection of two parts of the building is generally difficult. It is either by a ceiling light as in Fig. 133, or large side light windows are arranged at one end of the room as in Figs. 134, 135. Or the room may be lighted like the so-called " Berlin" room. Direct sun light is then usually introduced obliquely as in Fig. 142). For indirect lighting inside rooms, light courts or light shafts are frequently arranged, enclosed in the building and recieving direct light from above. These generally have a single or double glass roof (Fig. 136). By their enclosed location and high roofs ventilation is obstructed, light is not uniformly diffused, and the side walls are brightly lighted; but the glass or area should not be too small, not less

[illegible]

is also an effective protection against penetration of dampness in [illegible] only. This kind of light court, like that in Fig. 127 is frequently employed. Low lying windows must often be lighted by small light shafts constructed in the masonry opening in the exterior next the court or street [illegible].

[illegible] Lighting Fixtures.

[illegible] without influence on the plan of a room as the natural mode. [illegible] by means of combustion from lighting fixtures arises, and if these are also to serve for ventilation, this factor may within limits [illegible] the treatment of the room. How this may influence the form of [illegible] ceiling and of walls will be shown in the last chapter of this volume.

C. Arrangement of Chimneys and Heating Apparatus.

[illegible] Chimney Flues.

The choice of heating system and arrangement of heating apparatus are of great importance, both for room and for the building to which it belongs. We only consider apparatus for local heating, such as stoves, fireplaces, etc., connected with smoke and the flues, in regard to which it is to be noted, that they should be placed in the rear portion of the room and in the interior of the building, preferably in middle walls supported [illegible] masonry and material, in division walls in rooms and halls [illegible] in the first case, every other division wall as [illegible] ought to receive the flues, but frequently only the middle wall in the first case. According [illegible] chimneys, numerous exceptions from the rules occur in both cases. Such methods are required partly by different construction, partly by nature of the heating apparatus. The flue is objectionable when it projects from the walls. External walls are least suited to receive flues, partly from their less protected situation, partly for the great height to which they must rise from above the roof to a point higher than the ridge. In simple buildings with flat roofs, this objectionable feature will be very [illegible], while on rich facades with many roofs and gables, the chimney caps may be effectively employed as motives for artistic treatment of the external architecture.

[illegible]

[illegible] designed, and being fixed according to the uses of the room. This [illegible] to the question of kind of heating [illegible]

than 21.5 to 53.7 sq. ft. for light shaft, or 107.5 sq.ft. for light court. The ordinary "area" in English houses in blocks has many advantages, and is also an effective protection against penetration of dampness horizontally. This kind of light court, like that in Fig. 137 is frequently employed. Low lying cellars must often be lighted by small light shafts constructed in the masonry opening in the surface next the court or street being properly covered and protected (Figs. 138, 139).

105. Artificial Lighting.

The artificial lighting of rooms and location of lighting fixtures do not exert as much influence on the plan of a room as the natural mode. The removal of gases of combustion from lighting fixtures arises, and if these are also to serve for ventilation, this factor may within limits determine the treatment of the room. How this may influence the form of the ceiling and of halls will be shown in the last chapter of this volume.

c. Arrangement of Chimneys and Heating Apparatus.

106. Chimney Flues.

The choice of heating system and arrangement of heating apparatus are of great importance, both for room and for the building to which it belongs. We only mention apparatus for local heating, such as stoves, fireplaces, etc. connected with these are the flues, in regard to which it is to be noted, that they should be placed in the rear portion of the room and in the interior of the building, preferably in middle walls supporting beams in Germany and Austria, in division walls in France and England. In the last case, every other division wall is made thick enough to recieve the flues, but frequently only the middle wall in the first case. According to arrangement of walls and beams and to the weakening of masonry by openings, numerous exceptions from the rules occur in both cases. Both methods are required partly by different construction, partly by nature of the heating apparatus. The flue is objectionable when it projects from thin walls. External walls are least suited to recieve flues, partly from their less protected situation, partly for the great height to which they must rise free above the roof to a point higher than the ridge. In simple buiodings with flat roofs, this objectionable feature will be very visible, while on rich facades with steep roofs and gables, the chimney caps may be effectively employed as motives for artistic treatment of the external architecture.

107. Heating Apparatus.

Otherwise flues are to be arranged according to location of stove or fire-place, this being fixed according to the uses of the room. This raises the question of kind of heating apparatus, and whether it is to be sel-

[illegible] In the first case, the stove is [illegible] with use of the room, but in the second, [illegible] position as an ornamental object of interior decoration.

The fireplace with open fire in a hearth, common in France and England, but in Germany it occurs only in sumptuous buildings, then being usually combined with a central heating system; it is a very effective element in the decoration of walls, and is therefore arranged on the axis of a room, where it requires [illegible]. Its chief charm is the open fire and hearth, around which persons gather [illegible] a long wall [illegible] placed [illegible] large halls, [illegible] as in Fig. [illegible], [illegible] adjoining room.

The tile stove [illegible] placed at the middle of a long wall, as it projects much into the room. Space around the stove is not comfortable and furniture cannot be placed near the stove. In accordance with the [illegible] of the flue, the best place for it is in one of the rear angles next the middle wall, as in Figs. [illegible], or beside a door, where sufficient width exists. The use of the room decides the location of the usual [illegible] and iron stoves; it also locates the wall-stoves, which extend through the wall, as in Fig. [illegible], and heat two adjacent rooms. Stoves heated from the exterior were formerly common, but are no longer used and their great projection is thus avoided.

To avoid discomforts resulting from isolated heating, the only available [illegible] of radiators in separate and central heating, or the arrangement of openings for admission and removal of air, it may be briefly said that these are to be suited to the decoration of wall surfaces, and that due regard must be paid to the selected system of warming in the design.

Chapter 3. Forms of Buildings.

[illegible] General.

[illegible] general way the creation of an [illegible]

ected with sole reference to heating the room, or with regard to pleasing appearance. In the first case, the stove is so placed as to interfere least with use of the room, but in the second, it takes a prominent position as an ornamental object of internal decoration.

The fireplace with open fire is a luxury, common in France and England but in Germany it occurs only in sumptous buildings, then being usually combined with a central heating system. It is a very effective element in the decoration of walls, and is therefore arranged on the axis of a room, where it occupies slight depth but considerable width in rich designs. Its chief charm is the open fire and hearth, around which persons gather for cosy, quiet and intimate conversation, so that in social and family rooms it is best placed at the centre of a long wall (Fig. 140) or against a broad pier. In French plans it is often placed in a window recess. For rooms of societies and larger halls, a location between two doors is effective, as in Fig. 141, the opening above chimney breast being closed by a mirror or plate glass affording an effective view into the adjacent room.

The tile stove has been so perfected in form and color recently, that as an object for effect it is scarcely inferior to the fireplace, even sometimes surpassing that. Even if arranged with an open fire, it is seldom placed at the middle of a long wall, as it projects much into the room, space around the stove is not comfortable and furniture cannot be placed near the stove. In accordance with the location of the flue, the best place for it is in one of the rear angles next the middle wall, as in Figs. 142, 143, or beside a door, where sufficient width exists. The use of the room decides the location of the usual terra cotta and iron stoves; it also locates the wall-stoves, which extend through the wall, as in Fig. 144, and heat two adjacent rooms. Stoves heated from the esterior were formerly common, but are no longer used and their great projection is thus avoided.

To avoid discomforts resulting from isolated heating, the fully developed central heating systems offord means. Without discussing location of radiators in separate and central heating, or the arrangement of openings for admission and removal of air, it may be briefly said that these are to be suited to the decoration of wall surfaces, and that due regard must be paid to the selected system of warming in the design.

Chapter 3. Forms of Buildings.

108. General.

Without reference to its purpose, the erection of a building is in a general way the creation of an enclosed space. A building usually consists

of several rooms, serving for different purposes (Div. I, Chap. 1-9-12), arranged suitably beside and above each other. The last produces buildings of one or more stories, and according to their location, the cellars, basement, lower, ground, upper, and attic stories are distinguished, as well as intermediate or mezzanine stories.

109. Buildings without Internal Rooms.

The enclosure of space is not always the purpose of the building. For many buildings possess no internal rooms at all, or are without internal effect. Here partly belong those highly important works in ornamental architecture, which only serve an ideal purpose, embody a spontaneous idea of mankind, and are therefore erected as monuments in honor of the Diety, or in memory of notable events and persons. Isolated portals and gates belong here, as well as certain objects transferred to architecture, like fountains, wells, candelbra, vases, etc., which by nature and origin belong to other technical arts, and those pertaining to landscape gardening. But since external form is both beginning and end of this problem, and the design and arrangement of the building according to the views of esthetics, this is not the place to further consider them.

The following articles will treat only of the building in the usual meaning of the word, and as being produced by combination of separate space-forming parts. Progressing from simple to compound, and commencing with the ground plan of the building as a proper basis of the design, the exterior will only be regarded in its chief outlines.

a. Buildings of Simple Form.

110. Buildings containing a single room.

The building of the simplest type contains a single room, undivided in plan and elevation. Arts. 94 to 98 on forms of rooms in general apply here; but one is not restricted in choice of form of plan and ceiling, dimensions, etc., by consideration of adjoining rooms and parts of the building, and so far as the problem permits, may retain the artistic point of view. Simple and regular type forms are especially suitable here. These unpretentious structures frequently recieve richer treatment. The type form recieves extensions as in Figs. 110 to 115, and there appear modified as ante rooms. The problem often affors oppurtinity for use of rows of piers or columns, or of other space-dividing structural parts; a transformation upwards of the type form may often be observed, both in the interior and in the exterior of the building. It is generally furnished with a base or substructure, whose height is compensated by arranging steps.

In the external appearance of the building appears a free development of the architectural design, and if simple, especially in the form of roof;

[illegible]

... creative power (Figs. 148 to 157) ... [illegible]

The building is further changed, if the problem requires a division ... [illegible] ... in the interior of the building. In the last arrangement, a side tower is usually added ... for a stairway (Fig. 148), but the staircase is often built entirely in the roof. This is in ... almost invariably the case; their purpose is less to provide several rooms above each other, than a room of unusual height, necessarily limited or enclosed. The isolated tower is to be first considered, and which as a belfry, watch-tower, fortress-tower and gate-tower (Fig. 149), a look-out, water-tower, bridge-tower, lighthouse, a clock and bell tower ... [illegible], is capable of uncommonly varied treatment. It is indeed the crown of the building, ... [illegible]

But the tower is frequently not detached or isolated, but a very ... portion of the design of the building. For churches, city halls, etc., it has acquired ... as a staircase tower to connect different stories. [illegible]

for this directly indicates the type form. The form of ceiling is also of decided importance to the internal treatment, both in construction and form, and according to Art. 96, this may either freely span the room or require other supports between the walls. According to both methods, the structural system of the roof preferably approximates the form of treatment of ceiling of the room; but the latter is often entirely independent of the former. Both are influenced by arrangement and distances between points of support. These buildings, partly of very limited, and partly of very imposing dimensions, have in all ages been most extensively used in architecture as temples, chapels and mausoleums, lookouts or belvideres, pavilions and kiosks, etc., with simpler or richer treatment, and being intended for most diverse purposes, they afford suitable subjects for the artistic creative power (Figs. 145 to 147) Here likewise belong those very spacious buildings, where the nucleus of the design forms a single room, individed if possible, or a hall, then shaped in accordance with Div. 5, Chap. 4 of this volume. The noblest monuments for the worship of the Diety, the cathedral and the church, are also included, as well as enclosed structures of all kinds.

111. Tower-like Structures.

The building is further changed, if the problem requires a division of space in height, thus forming a design in two or more stories. A necessity then appears for connecting the stories, and stairs serve this purpose, there being sometimes arranged on the exterior, but are usually in the interior of the building. In the last arrangement, a side room is usually added to the principal apartment for a stairway (Fig. 148). Yet the staircase is often built free within the room. This is in towers almost invariably the case; their purpose is less to provide several rooms above each other, than a room of unusual height, necessarily limited or enclosed. The isolated tower is to be first considered, and which as a belfry, watch-tower, fortress-tower and gate-tower (Fig. 149), a lookout, water-tower, bridge-tower, lighthouse, a clock and bell tower or a campanile, is capable of unusually varied treatment. It is indeed the crown of the building, the expression of an elevated room, treated in accordance with the special purpose to be served, and generally affording a suitable and effective motive.

Yet the tower is frequently not detached or isolated, but a very characteristic portion of the design of the building. For churches, city halls, etc., it has acquired by tradition a typical importance. It usually serves as a staircase tower to connect different stories. But such a prominent and monumental architectural mass shall never be so degraded in its

[illegible] it is added as a mere [illegible] erring [illegible] the building [illegible] of these very [illegible]

1. Buildings of Compound Form.

1a. Principal Factors.

[illegible] two different things, which are of decisive importance in the general form of the structure and which can alone be considered here: the form of the plan and the shape of the roof.

From the latter results the upper terminations and from the former the [illegible]. If both are combined and are united by the vertical outer walls with due attention to the changes in form upwards, we not only produce thereby the external form of the building, but also an expression of its interior, sufficient for our purposes. This [illegible] room [illegible] for itself, and the room was considered as the element of the building in the preceding chapter.

1. Form of Plan.

1a. Arrangement of Rooms beside each other.

[illegible] but not in what order are the rooms to be arranged, and it must [illegible] whether the building is to be in one or in several stories [illegible] their other [illegible] and even with [illegible] dimensions, the ground [illegible] in several stories. [illegible] number and purposes of rooms, [illegible] require all rooms to be of equal height [illegible] arrangement of the staircases to connect [illegible] not [illegible]

[illegible]

[illegible] of all parts of the building [illegible] this [illegible] rooms [illegible] which [illegible] facilitate passage within the building [illegible] They are here only considered [illegible]

importance, that without any purpose, it is added as a mere accessory, and in paltry dimensions serves as the sport of an erring fancy. The preceding considers only the most important of the buildings of this class, but an impulse is given to deeper study of these very interesting and graceful creations of architecture.

b. Buildings of Compound Form.

112. Principal Points.

As in the case of simple forms of buildings, there again come under consideration two different things, which are of decisive importance in the general form of the structure and which can alone be considered here: the form of the plan and the shape of the roof.

From the latter results the upper terminationk and from the former in a manner, the lower ending. If both are combined and are united by the vertical outer walls with due attention to the changes in form upwards, we not only produce thereby the external form of the building, but also an expression of its interior, sufficient for our purposes. This suffices for the internal form so much the more, since each room appears for itself, and the room was described as the element of the building in the preceding chapter.

1. Form of Plan.

113. Arrangement of Rooms beside each other.

We will first take up number and sizes of the rooms. The question now arises, how and in what order are the rooms to be arranged, and it must first be decided, whether the building is to be in one or in several stories. With all rooms in one story, the horizontal extent of the building is naturally much greater, and even with limited dimensions, the ground form will quite differ from that arranged in several stories. The choice of either mode chiefly depends on number and purpose of rooms, and also on whether the uses of the building require all rooms to be of equal height or not. In the latter, arrangement of the staircases to connect different stories becomes very important; they do not exist in the first, or are of subordinate importance.

114. Rooms for Facilitating Access.

But in both cases, accessibility of all parts of the building is the first requirement in treatment of the plan, and this demands rooms for general use, which like stairways facilitate passage within the building. These are ante and connecting rooms, vestibules and entrance halls, halls and passages, courts, corridors, or galleries, stairways and lobbies. which for their importance are termed arteries of communication in the architectural organsim. They are here only considered in regard to utility and

[illegible] ground [illegible] by their [illegible] and [illegible] plan, they must be so arranged that separate parts of the building and the rooms may be [illegible] grouped by [illegible] compare [illegible] of these [illegible] plan, [illegible] compact arrangement of these [illegible] possible, [illegible] offices, in

[illegible] or passage suffices, in [illegible] rooms frequently oc-[illegible] that [illegible] in the treatment of complex forms of buildings, [illegible]

[illegible] corridors are best [illegible] and light and air are well admitted. Yet this is bad, when the corridor extends along a [illegible] fire wall, and the same occurs in case of a single corridor. Both arrangements are objectionable in many build-ings. When permissible, care must be taken in their lighting, partly by direct and partly by indirect light. Windows at ends serve for this pur-pose (Fig. 289), also bright corridors as in Fig. 290, or projections of corridors and stairways at proper places are better, and also light courts, [illegible] Width of corridors [illegible] It is least for servants' passages, and is [illegible] the possibility of [illegible] passage and of placing at the end [illegible] in extreme cases 2.64 to 2.99 ft. wall [illegible] if two persons are to pass each other, then 4.92 to 4.93 ft. will be necessary. [illegible] corridor in public buildings should have a width of at least [illegible] to 9.84 ft. A central corridor [illegible] is to be made correspondingly wider.

[illegible] the arrangement of corridors other-wise [illegible] surroundings, partly on the [illegible] arrangement chiefly results its [illegible]

[illegible] are grouped in organic sequence [illegible] the ground [illegible] will also be in-fluenced by other circumstances of a partly practical and partly theoret-ical nature, by number and size of parts of the building, by possibility [illegible]

suitability, and both the beauty and design of the building depend on their arrangement, connection, and their distribution in the ground plan. They must be so designed that separate parts of the building and the rooms may be readily accessible, easily separable, and at the same time may be opened for free admission of light and air. This will be best attained by a clear general plan, with a spacious, but compact arrangement of these means of communication.

While in simple deisgns for houses a vestibule or passage suffices, in extensive and complex forms of buildings, these ante rooms frequently occupy considerable extent. Their plans must be briefly mentioned, since they form a leading motive in the treatment of complex forms of buildings. (Div. 5, Chap. 1).

When permitted by the site and the money at command, corridors are best arranged along an external wall, since communication is thereby favored and light and air are best admitted. Yet this is bad, when the corridor extends along a common division of fire wall, and the same occurs in case of a middle corridor. Both arrangements are objectionable in many buildings. When permissible, care must be taken in their lighting, partly by direct and partly by indirect light. Windows at ends serve for this purpose (Fig. 152), also light corridors as in Fig. 150, or projections of corridors and stairways at proper places are better, and also light courts, skylights and glazed doors as mentioned in Art. 104. Width of corridors varies with their purpose. It is least for servants' passages, and is fixed by the possibility of convenient passage and of placing at the end a narrow door with its finish. In extreme cases 2.95 to 3.28 ft. will suffice; if two persons are to pass each other, then 4.26 to 4.93 ft. will be necessary. But a long or side corridor in public buildings should have a width of at least 6.56, or better 8.20 to 9.84 ft. A central corridor for frequent use is to be made correspondingly wider.

Like all rooms for communication, the arrangement of corridors otherwise depends partly on the building site and surroundings, partly on the purpose of the building, and from their arrangement chiefly results its ground form. For in their combination these rooms form the skeleton of the building, around which are grouped in organic sequence member by member, and room by room. The ground form of the building will also be influenced by other circumstances of a partly practical and partly theoretical nature, by number and size of parts of the building, by possibility of good lighting and abundant ventilation, by regard to external appearance, to suitability, to tradition, etc. Many kinds of buildings, as churches, theatres, hospitals, prisons, etc., have acquired typical ground

forms under the influence of these different causes.

115. Depth of Parts of Building.

The depth of parts of the building determine its form. It was shown in Art. 98 that one must be guided by dimensions of the different rooms, especially in fixing their height and depth in accordance with construction of the ceiling and possibility of good lighting by daylight, etc. Proceeding from these considerations, we find the average depth of a part of the building, as in Figs. 151 to 153; and from dimensions previously given and with due reference to the thickness of the walls, these are made as follows:-

1. For a plan composed of a single row of rooms with or without a longitudinal corridor, about 23 to 39.5 ft.

2. For a plan composed of two rows of rooms with a common central corridor, about 39.5 to 59.2 ft.

3. For a plan consisting of three rows of rooms with two corrdiors, about 59.2 to 82 ft. or more.

116. Extent in Length and Height.

The depth of a part of the building is determined thus, and unless unusually large rooms are provided, it will be kept within these limits. After either three arrangements is chosen, assuming the ordinary rectangular form, the length of the building is easily found, after the ground area to be covered has been approximately determined as explained in the next Chapter. Its height is afterwards most simply computed from number znd height of the different stories.

11u. Ground Form.

If the length obtained in this way differs little from depth of building, an approximately square or slightly rectangular form is given to it, and is usually one preferable (Fig. 154) It has been stated in Art. 94, that the former is more economical, because it requires least total length of enclosing walls, assuming these to be of uniform thickness. But the latter seldom occurs; it is for this reason otherwise in buildings divided by cross and middle walls, since the division walls of a square plan require greater length than for a rectangular one of equal area, though the converse is true of middle walls.

It is not possible without further discussion to state the preferable ratio of length to breadth of the rectangular form, this determination being based on the internal subdivision and must therefore be left to special cases. Yet in arranging in sequence a number of rooms of given areas in a selected form, it is advisable to give to it greater depth and thus a lesser extent of facade. Though greater total length of thin di-

vision with ... merely required, yet ... of which ...

ly outw... ... that support the ... lings and ...

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vision walls is thereby required, yet less extent of thicker and more costly outer and middle walls that support the ceilings and roof is necessary. To reduce the total length of the latter to a minimum is certainly most rational, though attainable only within certain limits. To fix these limits is important on account of cost, both for simple and frequently repeated designs, where maximum economy is required, and for large and important structures, since with their extent economy in cost increases. The general arrangement of plan must be fixed before relative dimensions of the ground form of building may be so computed, that with unchanged area, the total volume of walls may be made as small as possible. Attempts have been made to do this. Fuhrmann investigated detached buildings of rectangular form and those composed of rectangles. Meurer made similar inquiries, and went further by finding the cost of constructing the walls, and also that of excavations, and of constructing ceilings and roofs. Schmitt, for special buildings (houses for railway guards) assumed fixed areas for the different rooms, and computed dimensions of length and depth to be assigned to each room.

With a large ground area to be covered, and after depth of building has been determined, an elongated rectangle results as its general form. As usual for long external walls, projections are preferably arranged at the angles or center, as in Fig. 155, in order to thereby obtain better proportions of the masses in the treatment of the facade. Care must be taken to make these projecting masses either decidedly wider or narrower than the recessed wall surfaces. Approximately equal subdivisions produces monotony, and too frequent projections and recessions of relatively small dimensions have a disquieting effect. These projections also serve to accent important portions of the building, and should in all cases correspond with divisions into rooms in the interior.

Yet for a very extended length, it often becomes impossible to take the simple rectangle as ground form of the building. It is permissible to add wings to the main building. Combinations of rectangles are to be preferred, which suit the site and fit the programme, According to circumstances, combinations in Figs. 156 to 160 are suitable therefor, are partly symmetrical, partly unsymmetrical in arrangement. These are all open forms, or permit free access of light and air on all sides. With these may be contrasted closed ground forms having one or more internal courts, as in Figs. 161 to 164. Variations in Figs. 162, exhibit specimens of partly circular, partly oblique form.

Ground forms of greater extent and of varied shape result, when from detached dependent buildings for a common purpose, a united group of struct-

ures is to be formed. Figs. 185, 186, are examples, where buildings really belonging together in plan are in part closely, and in part loosely connected. In many designs of similar character, combination is intentionally avoided. The decision of which ground form is preferable must be left to the different cases; also whether symmetrical or unsymmetrical grouping is to be preferred. Referring to Div. I, Art. 21, it may be briefly stated, that not only in buildings of monumental importance, but also in those built in solid blocks, a symmetrical design is usually more suitable, and for isolated structures on elevated sites among picturesque natural surroundings, a freely and boldly subdivided type of plan is best adapted. The ground form must always correspond to the purpose and be truthful, therefore be developed from interior outwards; it must not be fixed with sole reference to external appearance and be an artificial exterior, but must be suited to the mass of the building. Hence one must not build from exterior inwards, but from interior outward, to determine the form. This treatment of the interior and the division of the plan in detail will be taken up in the next chapter, referring to selected examples. Aside from these, we must then examine different modes of treating the plan, originated by requirements and views of the time, which appear in the suprising and artificial forms of castles and palaces in the barocco and Rococo periods.

2. Treatment of Roof.

118. Ceiling.

The form of roof and the form of ceiling influence arrangement of plan in some buildings, especially in structures containing large rooms, and which belong with the halls and assembly buildings described in last division; otherwise, the plan influences the roof in form and construction. In regard to forms of ceilings of entire buildings, it may suffice to remark that according to Art. 99 ceilings are generally arranged in accordance with the division of the building into stories, and variations from this rule only occur in cases of especial importance.

119. Forms of Roof.

Treatment of the roof as upper termination of the structure is capable of unusual variation and improvement. It contributes to the characteristic and effective exterior of the building, not less than combination of the different masses and subdivision of these masses horizontally and vertically. These motives have an essential influence on the form of the roof, which is determined by the following factors:-

1. By the horizontal section or ground form of the building, which results from combination of the different parts of the structure and fol-

lows changes in direction of external walls.

2. By the vertical elevation, which either terminates at a common height or at different heights, according to whether the different masses of the building have the same number of stories or not.

3. By the form of cross section of the roof.

4. By the possibility of proper removal of rain water.

The first three factors occur in such varied ways, that their combined effect produces numberless forms. The fourth is no less important and causes important difficulties in buildings with closed forms of plan having two or three rows of rooms (Art. 115), as well as for houses in blocks and those of irregular plan. It is sometimes necessary to arrange the interior portion of the building as a kind of platform of slight slope, rain water pipes being carried down within the building itself, an arrangement only to be employed in the most extreme cases and with the greatest precautions. It is not necessary to investigate how the removal of water is best attained; yet this si shown in part by the following illustrations.

Some combinations of roofs are partly produced by variation of ground form and partly by difference in height, the upper termination of the building being effected by the surfaces of the roofs, as represented in Figs. 167 to 173. These are based on the most useful combinations of different parts of the building as described in Art. 117. These examples suffice to show the influence of form of roof on main form of the building, and to illustrate their external appearance, together with the grouping of the masses of the building resulting from form of plan. The illustrations are here based on the usual forms of sections already employed for simple forms of roof. They principally differ in greater or lesser inclination of plane roof surfaces, instead of which curvdd surfaces are common. From combination of these simple forms result compound profiles as in Fig. 174.

120. Development of Roofs.

That forms of roof are very capable of bold and graceful treatment is shown by numerous classical creations of the mediaeval and Renaissance periods, especially by monuments in northern countries, since men were there led by climatic conditions to the most suitable design for these portions of the building, for which these periods well understood how to invent artistic forms suiting the locality is proved by well known historical examples.

The same conditions exist now as in earlier times. The form of roof must afford protection from rain and sunshine, and this requirement must be expressed by its treatment. Why should we be ashamdd of this neces-

sary and rational construction and seek to conceal the covering of the buildings. The [illegible] built under [illegible] and for different customs, [illegible] to this error. This must be the reason that men formerly constructed flat roofs alone and neglected their coverings; for whatever is not readily visible receives no care. Roofs certainly afford motives for the picturesque adornment of the building, and masterpieces produced under conditions that still exist may serve as models.

It is then clear each part of the building must have its roof, and every important room must be distinguished by a crowning portion of the roof, gable, etc. This occurred during periods of highly developed architecture, and it was reserved for periods of decadence to place halls and kitchens, large and small rooms, under one roof and to clothe them with a monotonous covering. This is called "monumental repose". Such views have fortunately disappeared; men are convinced that by rational forms of buildings and by natural grouping of architectural masses better effect is produced than by rich ornament or without [illegible] and treatment. Employed in a moderate way, this is but a means of obtaining suitable importance for the modern rural building, as well as for the important monumental structure. Men have sometimes gone too far, and a danger exists that the picturesque element may obtain the mastery.

[illegible]

III. [illegible]

The process for the [illegible] in the erection of a building, has been brought within narrow limits, and we have more nearly attained the proposed end, the designing and requirements of the structure. Moreover to reach this end, besides the [illegible], neither system nor order must be lacking; an attempt will then be made to indicate the beginning points from which designing is to proceed, while some examples will be added as illustrations. Each problem must be considered as a whole, and in designing the plans, we must pass from the general sketches to details.

This is not opposed to the given law, to build from the interior outward and not from the exterior inward. But this comprises exactly the difference between research and invention, between study and general creation in architecture. To serve the requirements and arrangements of a building, and to deduce consequences for the plan of the building, are the process of study and solution of a problem. To commence with designing of [illegible] the [illegible] point, then to consider requirements in detail, [illegible] and bring them into harmony, is the method of [illegible]

sary and rational protection and seek to conceal the covering of the buildings. The stupid imitation of foreign monuments, built under another sky and for different customs, led to this error. This must be the reason that men recently constructed flat roofs alone and neglected their development. For whatever is not readily visible recieves no care. Roofs certainly afford motives for the uppermost adornment of the building, and masterpieces produced under conditions that still exist, may serve as models.

It is then clear each part of the building must have its roof, and every important room must be distinguished by a crowning portion of the roof, gable, etc. This occurred during periods of highly developed architecture, and it was reserved for periods of decadance to place halls and kitchens, large and small rooms, under one roof and to clothe then with a monotonous covering. This is called "monumental repose". Such views have fortunately dissapeared; men are convinced that by rational forms of buildings and by natural grouping of architectural masses better effect is produced than by vapid ornament or worn-out motives for architectural treatment. Employed in a massive way, this is but a means of obtaining suitable importance for the modest rural building, as well as for the prominenet monumental structure. Men have sometimes gone too far, and a danger exists that the picturesque element may obtain the mastery.

Chapter. 4. Designing.

121. General.

The problem for the architect in the erection of a building has been brought within narrow limits, and we have more nearly attained the proposed end, the designing and representation of the structure. Moreover to reach this aim, besides the creative idea, neither system nor order must be lacking; an attempt will then be made to indicate the beginning points from which designing is to proceed, while some examples will be added as illustrations. Each problem must be considered as a whole, and in designing the plans, we must pass from general sketches to details.

This is not opposed to the given law, to build from the interior outward and not from the exterior inward. For this comprises exactly the difference between research and invention, between study and personal creation in architecture. To solve the requirements and arrangements of a building, and to deduce conclusions for the plan of the building, are the process of study and solution of a problem. To commence with designing of structure as a single coherent whole, to pay due regard to its chief points, then to consider requirements in detail, to arrange all in order and bring them into harmony, is the method of independent creation and

of suitable design in each instance. This is first [illegible]

[illegible]

[illegible] Design.

The design intended for execution is not the work of a moment, [illegible] that of the first and best idea, appearing in a quickly made and [illegible]; only after hard labor and conquering the difficulties of the problem does the idea [illegible] followed by a second and a third, the work becomes simplified, obstacles [illegible] we suddenly see the path leading to our aim. Earlier sketches no longer [illegible] of the work, which is tried and changed, this part being transformed [illegible] natural place, as if it could not be otherwise, and the problem is solved [illegible] both stern cold knowledge and untiring creativeness are necessary.

[illegible] no doubts to appear; that disintegrating criticism of the creative thought, before this is developed, for despondency is just as objectionable as overweening self-conceit. One does not first lose himself in details, which readily arrange themselves afterwards. [illegible] and fresh for the work; it is then tested, changed, and again tested, which [illegible] of preliminary ground plan is most important. If the building be built up in the mind, one may have a general image of the entire work, but he cannot proceed at the same time with everything necessary to the [illegible]

[illegible] Plan of Site.

One should then commence with the location and extent of the building according to [illegible], and these are shown on the plan of the site. This contains the form of the ground for the building and its surroundings,

of artistic design in architecture. Thus to first hew the statue in the rough without regard to fashion of the clothing, to first fix the structural organism, to bring every member to its place, to concede prominence to the important, to retire the unimportant, to arrange and join everything in due sequence, and lastly, to give to work shape and form, is the problem for the first sketch.

122. Design.

The design intended for execution is not the work of a moment, or result of the first and best idea, appearing in a quickly made and talented sketch; only after hard labor and conquering the difficulties of the problem, does the idea attain perfect clearness. The first sketch is followed by a second and a third, the work becomes simplified, obstacles disappear, the essential becomes prominent and the unim.portant recedes, and we suddenly see the path leading to our aim. Earlier sketches no longer satisfy us; a new and better image of the object is before us; we lay hand again to the work, which is tried and changed, this part being transferred from right to left, that from front to rear; every part now assumes its natural place, as if it could not be otherwise, and the problem is solved. To bring it to this point, no pains are spared to test it again and again until the building is developed in clear and simple form, for which both stern self-knowledge and untiring creativeness are necessary.

Yet the plan comes first and then personal criticism. Never permit paralyzing doubt to appear, that disintegrating criticism of the creative thought, before this is developed, for despondency is just as objectionable as overweening self-conceit. One does not first loose himself in details, which readily arrange themselves afterwards. With pencil in hand and fresh for the work, it is then tested, changed, and again tested, which is the way to attain the end. In accordance with the preceding, the design of preliminary ground plan is most important. If the building be built up in the mind, one may have a general image of the entire work; but he cannot proceed at the same time with everything necessary to its graphical representation. He must commence with primary drawings, with the ground plan, and not with the elevation of the buiding. Attention is given to the ground plan first, and in designing it, the factors of the problem before developed and which influence external and internal forms of the building will be considered in the proper place.

123. Plan of Site.

One should then commence with the location and aspect of the building, according to Art. 88, and these are shown on the plan of the site. This exhibits the form of the ground for the building and its surroundings.

[illegible] from the general form of the structure, existing [illegible], plans of gardens and out-buildings, [illegible] should also be shown, and heights and other conditions of [illegible] and [illegible] in the best manner. The determination of the general plan is naturally first made; [illegible] required further study [illegible] being later studied. But in order to give [illegible] approximate extent and ground form of the building, [illegible] an approximate determination of area to be covered by the building is required. By the aid of the programme this is [illegible] as follows.

[illegible] Area of Ground Covered.

After the number and sizes of the several rooms have been fixed on the basis of space requirements of programme, and the total of superficial areas obtained therefrom, we add to this a certain per cent for thickness of the walls and for vestibules and rooms for passage, which varies for the chief kinds of buildings, and is to be so taken that sufficient margin remains for additions and necessities required in combining them together. [illegible] experience, [illegible] per cent for the buildings of [illegible], dwellings and private houses, and for buildings with very large rooms and proportionally few vestibules and corridors, etc., at 30 to 40 per cent for simple and compactly arranged [illegible] buildings with two rows of rooms and common central corridor, and at 60 to 100 per cent for rich and expensive designs of this kind with spacious [illegible] halls and stairways, corridors having rooms along one side only.

These numbers afford only a general and probable basis and are taken [illegible], but by comparison of the structure to be designed with executed buildings of similar character, the total floor area of all the [illegible] and after the number of stories has been fixed, the ground area to be covered is found approximately. [illegible] rooms are placed in a mezzanine story or in an attic extending over the [illegible] plan.

[illegible] General Arrangement.

After proceeding in this manner, especially in the larger programmes, and after the approximate cost of building has been estimated according to Art. 90, it is then proper to decide on the general arrangement of the building with due regard to its site and surroundings, and it should then be made clear according to Art. 177, whether it is to form [illegible], and be solid or [illegible] by [illegible] courts,

On it is provisionally drawn the ground form of the structure, existing or contemplated streets and alleys, plans of gardens and out-buildings, enclosures and gateways are also shown, and heights and other conditions of the ground are noted and utilized in the best manner. The determination of the general plan is naturally first made; this requires further attention, should the design be materially changed during later studies. But in order to give merely approximate extent and ground form of the buildingon the location plan, an approximate calculation of area to be covered by the building is required. By the aid of the programme this is usually made as follows.

124. Area of Ground Covered.

After the number and sizes of the useful rooms have been fixed on the basis of space requirements of programme, and the total of superficial areas obtained therefrom, we add to this a certain per cent for thickness of the walls and for vestibules and rooms for passage, which varies for the chief kinds of buildings, and is to be so taken that sufficient margin remains for additions and reductions required in combining them together. From experience, this may be taken at 30 to 40 per cent for buildings of utility, for ordinary dwellings and private houses, and for buildings with very large rooms and proportionally few vestibules and corridors, etc., at 50 to 70 per cent for simple and compactly arranged public buildings with two rows of rooms and common central corridors, and at 80 to 100 per cent for rich and expensive designs of this kind with spacious entrance halls and stairways, corridors having rooms along one side only.

The numbers afford only a general and probable basis and are taken within wide limits. But by comparison of the structure to be designed with executed buildings of similar character, the total floor area of all the stories of the former may be easily computed within closer limits, and after the number of stories has been fixed, the ground area to be covered is found approximately. It is to be considered next whether isolated rooms are placed in a mezzanine story or in an attic extending over the uppermost story.

125. General Arrangement.

After proceeding in this manner, especially in the larger programmes, and after the approximate cost of building has been estimated according to Art. 90, it is then proper to decide on the general arrangement of the building with due regard to its site and surroundings, and it should then be made clear according to Art. 117, whether it is to form merely a single enclosed mass, which must be solid or opened by one or more courts,

or whether separate wings of the building are to be arranged, and these are to be connected or detached, or finally, whether the whole may have an equal height, or whether some parts of the building are to be lower and others are to be made higher.

IV. Ground Plan.

Passing from general to details, from great to small, we then have to determine the principal rooms and the rooms subordinate to them, what rooms belong together, and which are to be separated, or briefly, how and where everything is to be most suitably placed on the plan. The requirements in [illegible] and advantages and disadvantages of the intended arrangement are to be considered together, and since it is never possible to have everything in equal perfection, the important must take precedence of the unimportant; accordingly even in the sketch ground plan, principal rooms are to be distinguished from others, that they may be recognized at the first glance.

The problem will be the more simple, the smaller the number of rooms to be designed in one story, and the more freely one can arrange them. Even combining together similar rooms in several stories presents no difficulties, [illegible] rooms of [illegible] in size and purpose, to be arranged beside and above each other. Not only depth, but also height of the rooms will then sometimes be dissimilar, and interruptions of the axes [illegible] become necessary; form and construction of the structure and its lighting will be more difficult, especially in rooms [illegible] large halls and at intersection of the wings of the building. Upon the suitable disposition of these intersections and at other [illegible] points of the plan, the connecting or vestibules, stairways, rooms with skylights, light courts, etc., with adjacent subordinate rooms, which are to be added at such places on the plan, depends chiefly the successful [illegible] of the problem.

In designing the plan [illegible] and the [illegible] in accordance with the arrangement of rooms and parts of the building, fixing depths of the rooms and lengths of [illegible] in accordance with previous statements, and proceeding with arrangement of wall masses and of rooms for communication. This is to be followed next after location of the principal rooms and of entrances to buildings, these being [illegible]. [illegible] entrances for [illegible] and for carriages are [illegible] connection [illegible] passageways, etc., rooms or essential part of [illegible]. [illegible] lines of axes and of [illegible] usually indicate [illegible] of the building

or whether separate wings of the building are to be arranged, and these are to be connected or detached, or finally, whether the whole may have an equal height, or whether some parts of the building are to be lower and others are to be made higher.

126. Ground Plan.

Passing from general to details, from great to small, we then have to determine the principal rooms and the rooms subordinate to them, what rooms belong together, and which are to be separated, or briefly, how and where everything is to be most suitablt placed on the plan. Requirements in detail and advantages and disadvantages of the intended arrangement are to be considered together, and since it is never possible to have everything in equal perfection, the important must take precedence of the unimportant; accordingly even in the sketch ground plan, chief rooms are to be distinguished from others, that they may be recognized at the first glance.

The problem will be the more simple, the smaller the number of rooms to be combindd in one story, and the more freely one can arrange them. Even combining together similar rooms in several stories presents no difficulties, compared with those of rooms varying greatly in size and purpose, to be arranged beside and above each other. Not only depth, but also height of the rooms will then sometimes be dissimilar, and interruptions of the stories become necessary; form and construction of the structure and its lighting will be more difficult, especially in rooms beneath large halls and at intersection of the wings of the building. Upon the skillful utilization of these intersections and of other unfavorably located portions of the plan, the connecting of vestibules, stairways, rooms with skylights, light courts, etc., with adjacent subordinate rooms, which are often added at such places on the plan, depends chiefly the successful solution of the problem.

In designing the plan, the lighting of all parts of the building determines the ground form and internal subdivision, and affects its general arrangement. We commence with the arrangement of rooms and parts of the building, fixing depths of the rooms and heights of stories in accordance with previous statements, then proceeding with arrangement of vestibules and of rooms for communication. This is to be decided next after location of the principal rooms and of entrances to buildings; these being the purpose of the former. Separate entrances for persons and for carriages are frequently required, whose proper connection with corridors, stairways, etc., forms an essential part of the problem. Center lines of halls and of entrances usually indicate axes of direction of the build-

[illegible] considerations [illegible] in connection [illegible]
[illegible] and pretentious structures. The [illegible]
[illegible] is [illegible]
[illegible], applied as it were [illegible] the masses of the building, [illegible]
[illegible] dimensions that often extend through the [illegible]
[illegible], or [illegible] buildings of [illegible].

[illegible] Subdivision by axes.

[illegible]

[illegible], offices or [illegible] in the [illegible], caused by the arrange-
ment of [illegible], passages, windows and doors,
[illegible] are [illegible], and consistently with re-
[illegible] and good construction, the axes of these structur-
[illegible] are equivalent to the [illegible] parts of the building, unless [illegible]
[illegible]
[illegible], and is a requirement of [illegible]
[illegible] and [illegible] are not violated [illegible]
[illegible] from [illegible] principles [illegible] in Art. [illegible], and be governed by [illegible]
[illegible]
[illegible]
vision of space in the building (Art. [illegible]), and for structural reasons it
must [illegible] subdivision by cross walls, floor [illegible]
[illegible] of vaults, etc., [illegible] upon [illegible].

That one may go too far is shown by the [illegible], which at the beginning
of this century were made of the squared system on the theories of Durand
[illegible], [illegible] and [illegible]
[illegible] is also to [illegible] by these artists, in their [illegible]
[illegible] of Palladio and of other masters which show a
[illegible] subdivision by axes. The arrangement of the [illegible]
[illegible] points of support determines the system of axes. This is evident in
[illegible], but also [illegible] in freely grouped struc-
tures, at least in their total masses. Good [illegible] in reference to [illegible]
[illegible] of measure such as a table for the system is given in the [illegible]
[illegible]
very large [illegible] it is [illegible] to make the scale of the [illegible]
[illegible] grouped, and subdivided.

[illegible]

After the [illegible] subdivision [illegible]
internal [illegible] is to be [illegible], and [illegible]
[illegible]

ing. Their coincidence is indispensable in monumental buildings, but is to be preferred in less pretentious structures. The principal axis of the building is perpendicular to its principal facade, the transverse axis extending parallel to it through the middle of the building. Parallel to these two directions side axes often extend through the centers of adjoining or receding buildings on each side.

127. Subdivision by Axes.

Subdivision by axes generally extends to the exterior, as well as the interior of the building, even if in freely combined and irregular ground forms, offsets or breaks in the middle lines occur, caused by the arrangement of the plan. If this be fixed in its chief points, windows and doors, colonnades and piers, are arranged accordingly; and consistently with requirements of order and good construction, the axes of these structural parts are equidistant in the respective parts of the building, unless a definite reason exists for varying from this. Adherence to regular axial subdivision facilitates designing, and is a requirement of architectural composition, when suitability and truth are not violated thereby. This results from ground principles developed in Div. I, and is proved by masterpieces of architecture of all times and countries. Yet the system of axes may not be taken at pleasure. The unit must result from the subdivision of space in the building (Art. 97), and for structural reasons it must harmonize with subdivision by cross walls, lines of piers, compartments of vaults, etc., and not be based upon a mere fancy.

That one may go too far is shown by the designs, which at the beginning of this century were made on the squared system on the theories of Durand and Weinbrenner, which exhibit advantages and disadvantages of their method. Reference is made to works by these authors, and their predecessors, to designs and writings of Palladio and of older masters, which show a rigidly symmetrical subdivision by axes. The arrangement of the principal points of support determines the system of axes. This is evident in larger plans, but also appears in smaller and in freely grouped structures, at least in their chief masses. Such data in reference to absolute unit of measure used as a basis for the system is given in the Table (Art. 100). A comparison of buildings shows that with both very small and very large axial distances it is possible to make the scale of the building clear by suitable grouping and subdivision.

128. The Elevations and Sections.

After the axial subdivision the treatment of external facades and of internal sections is to be arranged, and when the ground plan is substantially designed, sketches are made comprising main lines of facades and

of sections. When the design has progressed so far, a perspective view should be made for a detached building before it is worked out further; valuable indications are thus obtained for proportions and treatment of the architecture, which cannot be properly resented by the elevations alone. Eor its importance, this will be discussed in the nest Division. To illustrate and develop the ground princèpal of the designing, plans of some executed buildings will here be given, to indicate the method to be followed in certain cases.

a. Building detached on all Sides.

1. Freely Grouped.

129. Castle Stordalen in Sweden.

However unrestricted may be the plan of a building, the design generally shows an endeavor to arrange the principal parts of the structure symmetrically, to extend the main axis of the building, and to place its different masses according to axial subdivision. This appears in Castle Stordalen in Sweden (Figs. 175 to 177). The illustrations give no information in regard to the surroundings and orientation of the building. Yet the best facade is evidently the principal front, symmetrically arranged about a chief axis A B extending through the entire building. The principal apartments are evidently placed there, and are arranged on a transverse axis perpendicular to A B. In addition to the basement story, the space requirements of the problem are satisfied by a ground story, and a story in the Mansard roof. Other conditions of the programme permit an arrangement of the plan by grouping social rooms and family rooms on the ground and first floors around a common hall from which they are directly accessible and form a complete whole, but so connected that the principal apartments could be used without being disturbed by the housekeeping or by passage of servants.

With the location of the chief rooms on front, the main entrance and carriage porch are connected with the corridor and vestibule, the three latter being placed on the main axis, with the first on a transverse axis C D at the angle of the side and rear facades, all being connected by the principal staircase. The halls are lighted by ceiling lights in both stories. But a servant's staircase with a separate external entrance is required, and is most conveniently placed in the side wing to effectually isolate kitchen and servant's rooms in the basement, which are also directly accessible externally from an area. This produced the plan in Fig. 175. Around the vestibule and corridors are grouped the social, living, and sleeping rooms, of very imposing dimensions, and to which on extraordinary occasions could be added the best rooms of the Mansard story.

It is unnecessary to go further with the subdivision in detail; reference to the illustrations is sufficient, which exhibit an effective elevation of the side facade and the ground plan.

The total utilized area of ground and first stories is 11296 sq. ft., an average of 5648 sq. ft. per story; ground area covered is 7335 sq. ft. hence 30 per cent additional is required for walls and rooms for passage; vestibules are not included in the latter but put with useful rooms. and terraces, hall over the light court, etc., are omitted.

2. Symmetrical Arrangement.

130. Gewandhans at Leipzig.

The nex Gewandhans at Leipzig is a very instructive example of a symmetrically arranged building free on all sides (Figs. 178 to 181). As for requirements of the programme, on a site bounded by four streets the building stands free on all sides, but free development of ground plan was impossible, since its breadth was limited to 131.2 ft. The great concert hall is the starting point, and fulfilment of space, accoustic, and esthetic requirements is the aim of the artistic design. Everything else is only a means for the end but is scarcely less important practically. All influential factors led to the arrangement of two continuous stories, placing the great concert hall in the upper one, together with the adjoin-in gsmaller hall and the foyer. For its importance, the great hall is placed on two chief axes A B and C D and forms the nucleus of the building. The location of the small hall and of the foyer naturally occurred at front and rear ends on two subordinate axes parallel to C D symmetrically grouped in I form. Then from the prescribed total width of 131.2 ft., later increased to about 137.7 ft., as much space as possible was assigned to the width of the great concert hall, bringing these halls into convenient connection with each other and with the ground story.

It was most suitable for the given arrangement to place public stairways at both long sides and leading to different parts of the building. Two other stairways beneath the stage are placed on each side of the organ niche, and permit unobstructed access to the orchestra room and the soloists room, and longitudinal corridors lead to those for the public between the stairways, great hall, and foyer. The smaller hall is placed symmetrical with the foyer and furnished with two additional stairways and a small vestibule, and is located within the area of the old building, to be chiefly used for chamber concerts. But since evening entertainments are generally held therein, it is arranged that the stage and seats can easily be removed. In case of very great festivities, it and the foyer can be opened for general admission of the spectators.

This simple and clear arrangement of plan of principal story produced one equally satisfactory for the lower story. The latter was required to contain certain rooms in proper sequence, suitable to both admit and afford egress to audience and performers. A vestibule with three doors for persons on foot combined with two side vestibules for carriages to form the entrance hall. Next this on the main axis A B is the large hall with clothes room for gentlemen and ladies, then the vestibule to the smaller hall, and on the transverse axis are entrances to main stairways and to the boxes. The external and internal architecture (Figs. 179 and 180) produce a truthful and noble effect.

Without exhaustive detail, the great concert hall, measured between points of support of the ceiling, has approximately these proportions of length: Breadth : height :: 4 : 2 : 1.5 (124.5 : 62.3 : 47.9 ft), and including all boxes provides 1588 comfortable seats with space on the removable stage for 104 members of orchestra and 300 singers. The smaller concert hall has nearly the same proportions as the larger, or its length : breadth : height :: 4 : 2 : 1.4 (75.5 : 37.6 : 26.3 ft.), and contains 643 comfortable seats. For each seat in both halls (1588 + 643 = 2231) there are allowed an average of 13.15 to 13.45 sq. ft. of gross ground area covered by the building. If we compare the net useful area of the principal story (the lower story cannot be considered) with the ground area covered, an addition of over 75 per cent to the net useful area is required.

b. Building not detached on one or more Sides.

1. Rectangular Ground Plan.

131. Girl's School in Hamburg.

The Girl's School of St. John's Convent in Hamburg is represented in Figs. 183 and 184 and was built adjoining neighboring houses on a site with frontage of 141 ft. and average depth of 180.5 ft. The rooms required were class rooms for about 800 girls, singing and drawing rooms, gymnasium, large addience hall, residence of the director, and rooms for several female teachers, which required a building of three stories. From the restricted site of the building, it is obvious that a front wing with two rows of apartments and central corridor would not adequate, (Arts. 124, 116) making it necessary to add a wing extending the entire depth of the land, and consisting of a single row of rooms with side corridor. Local conditions (orientation and good lighting) made the location of this wing on the main axis A B of the building most suitable, thus producing a ground plan of T-form, placing most class rooms on the open and quiet garden front, with the great hall, the residence, and some elementary and seminary classes on the principal front.

With three rows of double desks and comfortable aisles, depth of the class rooms was made 21.7 ft.; those of gymnasium, drawing room, and of class rooms above these and in rear of the main building were 23.0 ft.; that of front elementary class rooms was 20.4. The central corridor between them for direct communication was rather narrow at 12.2 ft., the total depth of front building being fixed at 62.4 ft. Distance from street line being settled by the house adjoining on the right, the great hall was first placed at right angles to chief axis A B. It could then be set back to line of house adjacent on the left, and the entire depth to rear wall of the corridor assumed and a central scheme adopted, for which 131.2 ft. remained after cutting off two class rooms each on at right and left. Since the hall extended through two upper stories, its height was satisfactory.

It was evident that the entrance and main stairway should also be arranged on axis A B, the latter being at intersection (Art. 126) of front building and rear wing. The outlines of the wing were then laid out after width of corridor was fixed at 9.2 ft. and total width at 36.7 ft. To this corridor was added at the rear a stairway and a toilet room for each story, with covered portico before class rooms for use during bad weather. For central corridor of front building, stairways were likewise indispensable, especially in the upper stories. They were placed at each end with light courts and were further lighted by skylights. This was the general arrangement of the building, sufficiently illustrated by plan of passages (Fig. 182) and by plans in Figs. 183 and 184. Arrangement of ground story and subdivision of the class rooms, living rooms, etc., do not require further notice.

For each seat there is allowed about 16.2 sq. ft. ground area covered by the building, including rooms for common use and the residences. If the three stories are taken and the average utilized area be compared with total ground area covered (the hall being counted as a single story), the latter exceeds the former by about 90 per cent.

2. Partially Oblique Ground Form.

132. Palace of Archduke Louis Victor in Vienna.

This usually results from the form of the site, especially when buildings are erected in blocks. This is the case in Palace in Vienna (Figs. 185 to 188). This site was very restricted in both location abd area (15600 sq. ft.) and a further requirement was made that the palace should have external similarity and height with the residence of Von Wertheim, then being constructed on the opposite corner.

To explain the general plan, it is only necessary to mention the require-

Above the cellar story with its kitchen and store rooms, laundry, etc. [illegible] a ground story for stables, coach house and servants' rooms was required; then a mezzanine story intended as a part of the living rooms of the servants and the household. The first principal story was used for the residential apartments, the salon of the ambassador and the living apartments of the [illegible]; the second principal story containing other [illegible] and apartments for the household and [illegible]. The entrance hall, the principal stairway, and the [illegible] salon in the first principal story were recognized as the chief objects for dignified architectural treatment. The salon became the starting point. Its location [illegible] Palace, the entrance hall [illegible] the direction of main axis [illegible], all are naturally indicated. At the right of the salon there could be placed the dining hall, divided from the living apartments. The [illegible] depth of the [illegible] required the same depth of the salon on account of the limited space, but the salon [illegible] required for external [illegible] of the building by the [illegible] façade. The projection of this part of the building was taken by the [illegible] arrangement and by the [illegible] of the two halls from the [illegible] wall.

After these principal apartments had been previously fixed, there remained the salon entrance of the ambassador and the apartments of the [illegible] [illegible] the fronts on King St. and on [illegible] St. A wing could then be carried along King St. façade with a depth of 29.3 ft. and one on [illegible] St. 24.6 ft. deep, the obtuse angle being properly adjusted by one circular bay. The plan was thus externally completed. To give a spacious and beautiful court and a grand and dignified stairway in the remaining internal space was no slight problem. Without injury to [illegible], this was solved by placing the staircase at right angles in the corner of the palace, starting on transverse axis of entrance [illegible] leading through mezzanine story and ending there. According to the [illegible] on the plans, a wing 28.[illegible] ft. wide was set out, and the connecting wing was 21.4 ft. wide on the King St. front, with a vestibule [illegible]. [illegible] behind the [illegible] salon, a narrow corridor opposite forms the [illegible] side of the court which is 43.[illegible] ft. long and 28.0 ft. wide, the walls [illegible] of arcades with three [illegible] openings each, and windows for light[illegible] [illegible] leads to a [illegible]

ments of the programme.

Above the cellar story with its kitchen and store rooms, laundry and bath rooms, a ground story for stables, coach house and servants' rooms was required, then a mezzanine story intended as a part of the living rooms of the Archduke and his household. The first principal story was taken for the social apartments, the salon of the Archduke and the living apartments of the Archduchess, the second principal story containing other living apartments for the household and the servants. The entrance hall, the principal stairway, and the festal salon in the first principal story were designated as the chief objects for dignified architectural treatment. The salon became the starting point. Its location directly on Schwartzenburg Palace, the entrance hall beneath A, the direction of main axis A B, all are naturally indicated. At the right of the festal salon could be placed the dining hall, dtached from the living apartments. The joderate depth of the latter required the same depth of the salon on account of the limited space, but the salon obtained width required for external appearance of the building by the flanking angle bays on the principal facade. The projection of this part of the building was fixed by the internal arrangement and by the different depths of the two halls from the continuous middle wall.

After these principal apartments had been previously fixed, there remained the salon suite of the Archduke and the apartments of the Archduchess on the fronts on Ring St. and on Pestalozzi St. A wing could then be carried along Ring St. facade with a depth of 29.5 ft. and one along Pestalozzi St. 24.6 ft. deep, the obtuse angle being properly adjusted by the circular bay. The plan was thus externally completed. To plan a spacious and beautiful court and a grand and dignified stairway in the remaining internal space was no slight problem. Without injury to general effect, this was solved by placing the staircase at right angles in the corner of the palace, starting on transverse axis of entrance hall, leading through mezzanine story and ending there. According to the limits on the place, a wing 26.3 ft. wide was cut off, and the conservatory was made 21.4 ft. wide on the Ring St. front, with a vestibule 14.1 ft. wide behind the festal salon. A narrower corridor opposite forms the fourth side of the court which is 46.0 ft. long and 36.0 ft. wide, its walls composed of arcades with three and four openings each, and windows for lighting the apartments. That corridor leads to a side staircase placed be~~hind~~ tween sides of the angle and at apex of the internal triangle produced by irregularity of the site. The remaining space is employed for adding subordinate rooms and a light court at the rear of the adjacent

This is the general arrangement of the principal story, illustrated by the plan of the program, Fig. 160. The division in detail proceeds with- [illegible] is the ground story with [illegible] entrance hall, the arrangement of the stair- case, and the [illegible] passage from [illegible] to Festsaal [illegible] The principal facade is shown in Fig. [illegible] the ground area covered will [illegible] the building [illegible] limited to the principal story and an addition of 50 per cent [illegible] is required. The limits for these explanations would be exceeded, [illegible] were discussed further; the way is opened to be pursued in the next division.

Part IV.

[illegible]

by Professor Joseph Bühlmann.

Chapter 1. Forms of Facades.

1. General.

The appearance of a building depends on two factors. The first is the form of its entire mass, which [illegible] and at a distance than its [illegible] proportions. Secondly come the vertical surfaces of these masses, usually only visible near at hand, but which by their subdivision and ornamentation produce the particular impression of individual artistic effect. It will be best to briefly summarize that said in the preceding division on the first point.

The mass of a building may be united or closed, may be divided in [illegible] or be grouped. A closed form produces a simple prismoidal, cylindrical, or pyramidal mass, if the programme proposes a very simple purpose, fulfilled by a single room, or if similarity of required rooms permits them to be combined in a single united form, indicated by reasons of construction and suitability. A grouping of the entire building occurs if the building programme requires a number of rooms, serving to unite [illegible] The organic connection of the different rooms requires a predominance of [illegible] portion and subordinate massing of less important rooms in a symmetri- [illegible]

structure.

This is the general arrangement of the principal story, illustrated by the plan of the passages, Fig. 188. Subdivision in detail proceeds without further difficulty, like the lower story. Of especial interest is the ground story with noble entrance hall, the commencement of the staircase, and the carriage passage from Schwartzenburg Place to Pestalozzi St. The principal facade is shown in Fig. 187 and corresponds to the requirements of the problem. A comparison of the ground area covered with the utilized area is limited to the principal story and an addition of 80 per cent to the latter is required. The limits for these explanations would be exceeded, if the method for designing were discussed further. The way is opened to be pursued in the next Division.

DIVISION IV.

TREATMENT OF EXTERNAL AND INTERNAL ARCHITECTURE.

By Professor Joesph Buhlmann.

Chapter 1. Forms of Facades.

133. General.

The appearance of a building depends on two factors. The first is the form of its entire mass, which primarily impresses itself upon an observer, and at a distance this is alone perceptible. Secondly come the vertical surfaces of these masses, usually only visible near at hand, but which by their subdivision and ornamentation produce the particular impression or individual artistic effect. It will be best to briefly summarize that said in the preceding Division on the first point.

The mass of a building may be united or closed, may be divided in detached masses or be grouped. A closed form produces a simple prismoidal, cylindrical, or pyramidal mass, if the programme proposes a very simple purpose, fulfilled by a single room, or if similarity of required rooms permits them to be combined in a single united form, indicated by reasons of construction and suitability. A grouping of the entire building occurs if the building programme requires a number of rooms, serving for unlike purposes, and which can properly be arranged only in separate buildings. The organic connection of the different rooms requires a combination of the masses into a single architectural whole. By prominence of the chief portion and subordinate annexing of less important rooms in a symmetrical position along a main axis, diversity of such an architectural group produces a united and organic appearance. Since the arrangement of rooms

affects the external form of the entire building. It is clear then in designing the ground plan, the [illegible] must be considered, so that plan and elevation can in their essentials, thus only be designed together.

In Chapter I of this Division forms of houses is treated with a consideration of the different purposes of the building, only in regard to external form, this can only occur for simple and detached forms of buildings, or for separate architectural masses forming portions of grouped structures. [illegible] of them, and even in the employment of the different structural forms to be treated in accordance with the desired purposes.

(a). Construction of External Walls.

External walls or facades of every structure are first of all [illegible] the wall [illegible] If the wall requires [illegible] the openings [illegible] and piers [illegible] of structural masses between them. The protection of the external surfaces by a projecting roof or cornice [illegible] may be considered as a structural requirement. Thus the external walls of a structure may produce a [illegible] construction, they must have a combination ensuring the greatest possible strength, and [illegible] may be employed possessing great resistance to all external influences.

[illegible] work of wooden posts and beams produce no monumental impression, because of the slight durability of the materials, and by the relatively [illegible] is possible.

(b). [illegible]

[illegible] which [illegible] the vertical elevation in a manner appropriate to this [illegible] tion. According to this view of the treatment of the facade, [illegible] as essential parts of every facade: —

[illegible]

affects the external form of the entire building, it is clear that in designing the ground plan, the external appearance must be considered, so that plan and elevation can in their essemtial forms only be designed together.

If in Chapter 1 of this Division forms of facades be treated without examination of the different purposes of the building, only in regard to external form, this can only occur for single and detached forms of buildings, or for separate architectural masses forming portions of grouped structures. The grouping may here be considered only from ordinary points of view, and must in the expression of the different structural forms be treated in accordance with the diverse purposes.

134. Construction of External Walls.

External surfaces or facades of every structure are first dependent upon the construction of the external walls. This requires a vertical position of the walls, their diminished thickness upwards with resulting batter or offsets; it further requires placing the openings above each other and a firm and pier-like treatment of structural masses between them. Even protection of the external surfaces by a projecting roof or cornice may under some circumstances be considered as a structural requirement. That the external walls of a structure may produce a durable and monumental impression, they must have a combination assuring the greatest possible strength, and materials must be employed possessing great resistance to all external influences.

As the simplest construction a superposition in courses or a stratification of the material, and natural or artificial stone has proved to be the most suitable and durable material. All walls constructed of a framework of wooden posts and beams produce no monumental impression, on account of the slight durability of the materials, and by the relatively small strength of the construction itself. Yet upper terminations of facades may have a projecting frammed construction in simple corbelled form, and this may be so treated as to harmonize with the stone wall in regard to durability.

135. Vertical subdivision of Building.

The artistic treatment of facades naturally follows the construction; it first strives to produce an effect of stable resistance, which essentially determines the monumental appearance of the architecture, and then subdivides the vertical elevation in a manner appropriate to firm construction. According to this view of the treatment of the facade, there result as essential parts of every facade:-

1. A firm foundation or a thickening of the wall interposed between

it and the ground. This footing becomes externally a platform or a base course, on which the building appears to be built. It may consist of a strongly projecting base or of a high and slightly projecting offset. It always demands simple form without ornament and the expression of great resistance, best produced by using conspicuous and massive cut ashlars with wide beds.

2. The actual enclosure of space by vertically aspiring walls, whose structure is externally shown by the horizontal courses. In ashlar masonry, a reduction of height of the rate courses upwards corresponds to diminished thickness of the wall, and more readily permits this to appear with the increased height.

3. The projecting edge of the roof above the wall is supported by the uppermost and projecting cour ces of the wall, these together composing the crowning entablature. In most monumental forms, the edge of the roof is exclusively supported by stone courses, which are of different forms but compose a homogeneous stone entablature. In contrast with the development of the base or footing, these upper and prominent courses should have a character of the greatest lightness; they should represent the free ending, the uppermost termination. These peculiarities belong in a high degree to entablatures of wood, and it is therefore natural that forms originally worked out in wood should have become, and continued to be typical for stone entablatures also.

136. Horizontal Subdivision of Building.

While the construction of the building necessitates subdivision in a vertical direction, the purpose of the structure causes a division horizontally. This horizontal division usually extends from the center as an axis of similar masses or of symmetry, arranging the masses on both sides of this similarly, and placing terminations at each end. As for special treatment of the centre in accordance with purpose of the building, this may be developed from a simple portal to a richly treated central architectural mass. The side terminations first appear in using at the angles a stronger material, larger ashlars, or projecting pilasters or piers for strengthening the wall. In extended designs of facades, these endings consist of special architectural masses, to which is assigned an importance subordinate to that of the central mass. The vertical and horizontal subdivisions must permit the facade to appear as a unity, to which nothing can be added or removed without thereby injuring its perfection.

Every building must stand in contrast to its surroundings as an organic whole, only appearing to be connected to the ground by the universal law of gravity. Around the chief apartment for material or ideal uses,

through which passes the principal vertical axis of [illegible]
[illegible]
ing from the [illegible]. The enclosed [illegible]
[illegible] in accordance with the law of growth and in opposition to the force of gravity. The external surface or facade of the building causes these internal [illegible] of the whole to appear externally; it expresses both structural requirements and the intellectual importance of the building.

4. [illegible]

[illegible] Influence of Construction.

If in the design of the facade structural elements alone appear, a simpler and severer character will thereby be produced. The particular expression is that of the mode of construction, which is dependent on building material and mode of masonry. By expression, severely executed in even the external appearance, only a very moderate variety of form can be produced, and such a treatment of the facade cannot rise above the rude character of mere utility. But structural forms may assume decorative shapes and may be combined with forms not structurally necessary, but which only serve for expressing a function, without dropping the rules [illegible] of the construction. [illegible] used independently of the structural combinations, may lend grace and elegance to a building otherwise cold and severe.

[illegible] Facades.

[illegible]
[illegible]
[illegible] decorated by drafted margins and raised bosses (Fig. [illegible]). A wall composed of dressed ashlars possesses equally in all parts great stability, to especially emphasize angles of projection or courses at the levels of the ceilings does not appear to be required. As for heavy [illegible]
[illegible]
ing. A projecting course of large ashlars may be covered by a slab above a chair, that being transformed to a seat. The bosses of the vertical wall may rest directly on this bench; yet the architecture of the Early [illegible]
[illegible] for a base, and employed these together to compose a bordering band with [illegible]
[illegible]
of the [illegible], [illegible] bosses, or by lintels, if moderate in width.

[illegible]

through which passes the principal vertical axis of the central portion of the elevation, subordinate rooms are grouped along horizontal axes extending from the center. The enclosed space rises from a firm base and extends upward in accordance with the laws of growth and in opposition to the force of gravity. The external surface or facade of the building causes these internal factors of the whole to appear externally; it expresses both structural requirements and the intellectual importance of the building.

a. Vertical Subdivision of Facade.

137. Expression of Construction.

If in the design of the facade structural elements alone appear, a simpler and severer character will thereby be produced. The particular expression is that of the mode of construction, which is dependent on building material and kind of masonry. By a construction severly executed in even the external appearance, only a very moderate variety of form can be produced, and such a treatment of the facade cannot rise above the rude character of mere utility. Yet structural forms may assume decorative shapes and may be combined with forms not structurally necessary, but which only serve for expressing a function, without dropping the rude character corresponding to the construction. Decorative accessories, used independently of the structural combinations, may lend grace and elegance to a building otherwise cold and severe.

138. Rusticated Facades.

Rusticated facades are the simplest and the most monumental form of structural facades, and are produced when in ashlar masonry the separate blocks are decorated by drafted margins and raised bosses (Fig. 189). A wall composed of dressed ashlars possesses equally in all parts great stability; to especially emphasize angles of projections or courses at the levels of the ceilings does not appear to be required. As for heavy masonry, the base of this form of facade must be massive and strongly projecting. A projecting course of large ashlars may be covered by a slab above a step, thus being transformed to a seat. The bosses of the vertical wall may rest directly on this bench; yet the architecture of the Early Renaissance frequently placed there an intermediate cyma of form suitable for a base, and employed these together to compose a bordering band with a strong effect of shadow. In accordance with the structural character of the architecture, door and window openings were spanned by arches with bosses, or by lintels, if moderate in width.

Within the larger window openings is a recessed wall with graceful treatment in contrast to the stiff ashlar masonry and having an excellent effect (Fig. 190). Like a continuous band or belt with slight projection

and a gently curved cyma and dentil band, the window sill is effectively contrasted with courses of bosses and forms an easy division of the surfaces, without actually interrupting their vertical tendency. The window sill as a belt-course is nothing more than a slightly projecting and ornamented course of stone, and its height should therefore coincide with that of the other ashlar courses. The entrance door or gateway likewise requires jambs inside the bosses, and these may be developed from a plain reveal to a strongly profiled architrave (Fig. 191). A considerable depth of jamb is always required to produce the necessary appearance of stability. No rectangular window in the ground story or in any mezzanine story may dispense with an architrave next the bosses. It appears unsuitable to place large rectangular doors or windows in a rusticated wall and give them architraves, whose forms were derived from wooden construction, requiring straight lintels to support the masonry above them. The stability of the wall then appears to the eye as if injured by an insufficiently strong covering of the openings.

The entablature may always borrow its forms from entablatures of antique columnar orders, which chiefly originated in wooden construction; the Corinthian type with its rich subdivisions especially forms an effective contrast to the simple rusticated wall. Yet entablatures which appeared later in stone construction deserve full consideration in spite of their massiveness. The mediaeval cornice of Italian- palace-castles composed of tall inclined corbels supporting stone slabs was the motive for a corresponding form of Renaissance entablature. A stone course decorated by a cyma moulding forms the base for corbels or consoles. These are inclined supports beneath the cornice that recieve an ornamental form, which expresses their purposes. Above the slab and connected with it by its cyma moulding, the cornice rises as a free ending. Square spaces between consoles are suitable localities for rich decorative ornament in strong relief. (Fig. 192). If antique entablatures, those most suitable having forms much subdivided and rectangular or ogee consoles, be employed to crown ashlar walls, they must be treated with imposing height and severity to harmonize with the character of the lower architecture. By architects in the Florentine Renaissance the principle appears to have been established, that the entablature above a palace must be made large enough to be suitable for a colonnade of equal height. For the Corinthian type of entablature, this is from one twelfth to one-fourteenth the entire height. A plain frieze is divided from the wall surface by a boldly profiled course which preferably separated the refined forms of the cornice from the rusticated work.

The rusticated wall may in its height be changed from heavy to light effect by reducing height of ashlars and projections of bosses in the different stories. (Fig. 193) External surfaces of stones may vary from a boss of semicircular section to a flat boss with rounded edges. In old facades of this kind, the ground story is usually enclosed and has small windows. Yet there remain from the Renaissance period fine examples of such facades with great lower arched openings, likewise suitable for modern purposes. The completely rusticated facade emphasizes unity of vertical enclosure of space and combines different stories into a single form. The diverse character of the different stories may then be expressed only by dimensions and shape of window openings, while the proper subdivisions and especially the frame-work of the floor, do not appear externally. By their grand and simple form and their monumental stability, such facades make an imposing impression; yet they likewise possess a monotonous and gloomy character.

139. Richer Facades.

A facade of richer form is produced, if the elements of the vertical structure are apparent externally according to their importance. This may be done by making prominent the separate stories by limiting belt courses and by ornamental enclosures of their window openings. For this purpose forms are usually employed that did not originate in stone, but by their use in structures first built in wood and later in stone, they have acquired an expression suited to the latter material. To the esthetic character of these forms, retained even in the translation into stone, structural jointing of the wall must not be too strongly opposed or be but slightly contrasted, otherwise insoluble contradictions will arise. But in portions of the facade requiring special stability, an external prominence of structural forms is indicated. The ground story and the angles of projections may be treated as rusticated work, thereby forming an effective contrast with the smooth wall surfaces of the upper portion, which merely appears as a background for ornamental architraves of windows. (Fig. 194). In such forms of facades, with simple general form having clear subdivision, a great wealth of details and ornamental accessories may be developed. Yet the general character of the facade retains a certain strength and severity, while the general mass of the building appears as a quiet wall surface, where aspiration and opposition to force of gravity are not yet expressed by special forms. Special treatment of such facades will be in accordance with the number of stories, and it is then necessary to consider them in this respect.

140. Buildings of Two Stories.

In a building of two stories, the principal story may either be placed above a high ground story (Fig. 195), or may be placed directly above a low structure, then supporting an upper story. In both cases, a belt course is arranged externally at the level of the floor of the principal story, appearing as a high and slightly projecting course or band. The pedestal band required between this belt and the window openings has its own base and cap. The former is of simple and slightly projecting form, being scarcely visible above the belt from beneath, but the latter is formed with plinth and cyma mouldings. To make it prominent, the principal story demands an especially characteristic enclosure of the windows. Therefore that rich form may be employed, which is composed of a small shrine (Aedicula), having columns or pilasters and an architrave inside them. Pedestals for columns or pilasters will project from the pedestal band; between these and before the windows may be placed slightly projecting balconies with balusters. The strength of the belt course permits the projection of a balcony to its outer edge. The entablature of the pediment cap appears firmly joined to the wall, if the architrave and cornice extend along the wall as flat bands representing special courses of stone. The spaces enclosed between the enclosures of the windows and these bands are suitable for painted or sgraffito ornamentation, or for niches and figures.

As a massive band, the belt course is not broken around the angles; but the pedestal band must form a pedestal beneath the angle quoins and it then projects from the pedestal as much as the bosses (Fig. 196). If the principal story is placed above a ground story, the latter has a massive character by ashlar masonry, or at least by simple and plain forms of windows. Arched windows may be conveniently employed in the ground story, but those with straight lintels are to be used in the upper story. Between the windows of the principal story and the main entablature should be a wall space at least equal to the clear height of the window; but subordinate windows of mezzanine stories may be placed directly beneath the entablature and be connected with a broad frieze decoration. Only bosses of angle quoins project beyond the wall surfaces, the drafted margins being flush. Belt courses and frieze bands are then extended through these bosses straight to the angle without breaks. The Corinthian form of entablature is in height arc-fifteenth to arc-eighteenth part of the height of the facade. Its frieze beneath it has a good effect as a termination of the wall and transition to the cornice, while it forms together with the cornice a rich crown to the building.

[illegible]. Division of [illegible] Courses.

In designs presenting several stories, the principal story is usually placed over [illegible]
[illegible]
[illegible] ground story [illegible]
ment. If only a single story be placed above the principal story, then no continuous wall space above the windows of the former, a belt course is only placed below the windows of the upper story. In contrast to the lower belt course indicating the floor, this is composed of a thin slab and some mouldings; a narrow frieze band beneath this gives it the height required for effective division of the surface.

If more than two upper stories are arranged above the ground story, it is then best to divide the facade into three principal divisions, the lower one being subordinated as the base, the middle one or highest one being the substructure, and the uppermost one of less height being the crowning and dominant portion. The substructure may comprise both ground and mezzanine stories, [illegible] principal story, [illegible] vertical forms, the windows of the next story are placed directly above the entablature of the lower ones. But the lower windows must then have a strong architecture and the upper ones have light architecture. If treated with heavy piers, these stories require a isolated appearance. The highest story will be joined with the main entablature like a deep frieze. The windows there (if used) are connected by a band like an architrave, and must be separated from the main entablature by a frieze band. Surfaces between windows have light ornamental decoration by panelling or sgraffito work.

The portal usually indicates the axis of symmetry in the centre of the facade, and it may receive a rusticated arch or be enclosed by forms of the columnar orders. The columns should then be of the same height as the basement course, when the forms of the cornice and base may differ in according [illegible] with the ground story. The portal architecture may extend through the entire height of the substructure.

[illegible]. Facades in Ordinary Brick Masonry.

Facades in brick masonry with moulded bricks for belts, cornices, and architraves, may be treated with reference to peculiarities of the material [illegible] may be not richer than a rectangular architrave of stone, with filling between arch and architrave. The material requires slight projections of belts and [illegible]

141. Buildings of Several Stories.

In designs containing several stories, the principal story is usually placed over the ground story, the latter being treated as the substructure for the facade (Fig. 197). A subordinate mezzanine story may be interposed between these two stories and combined with the ground story on the exterior. If only a single story be placed above the principal story, then to obtain free wall space above the windows of the former, a belt course is only placed below the windows of the upper story. In contrast to the lower belt course indicating the floor, this is composed of a thin slab and cyma mouldings; a narrow frieze band beneath them gives it the height required for effective division of the surface.

If more than two upper stories are arranged above the ground story, it is then best to divide the facade into three principal surfaces, the lower one being characterized as the base, the middle one or highest one being the superstructure, and the uppermost one of less height being the crowning and dominant portion. The substructure may comprise both ground and mezzanine stories. Above the principal story, characterized by its external forms, the windows of the next story are placed directly above the entablature of the lower ones. Yet the lower windows must then have a strong projection and the upper ones have flat architraves; if treated too nearly alike, these easily recieve a stilted appearance. The highest story will be joined with the main entablature like a deep frieze. Its window caps (if used) are connected by a band like an architrave, and must be separated from the main entablature by a frieze band. Surfaces between windows have light ornamental decoration by painting or sgraffito-work.

The portal usually indicates the axis of symmetry in the centre of the facade, and it may recieve a rusticated arch or be enclosed by forms of the columnar orders. Its cornice should then be at the same height as the belt course, when the forms of the cornice and belt may differ in accordance with their varying importance. If a mezzanine story be connected with the ground story, the portal architecture may extend through the entire height of the substructure.

142. Facades in Ordinary Brick Masonry.

Facades in brick masonry with moulded bricks for belts, cornices, and architraves, may be treated with reference to peculiarities of the material in a pleasing and monumental way. Openings are to be arched, but there may be set within them a rectangular architrave of stone, with filling between arch and architrave. The material requires slight projections of belts and decorations so that the numerous abutting joints may not become appar-

ent, and beaded astragals, dentils, grooves on bands, etc. Continuous friezes and panels of pilasters must be so arranged on the drawings, that with repeats of the same forms they may appear connected and flowing. Architraves of doors and windows may be composed of decorated cyma mouldings and frieze-like bands, producing their effect less by bold relief than by rich ornament and clean profiles. The entablature is composed of several courses with projecting consoles, and in brick alone may produce an effective crown to the facade, but this should be combined with a wooden cornice attached to the rafters and projecting above it. If large openings or porticoes are in the ground story, piers or columns must necessarily be of cut stone. Excellent models are supplied by brick facades of Renaissance period in Bologna.

Certain portions of brick facades may be decorated by relief ornaments in terra cotta, especially the frieze above ground story or beneath the main cornice, and panels between the windows. A rich frieze is particularly suitable above an open portico in the ground story. This should be bordered above by a delicately profiled belt course, and beneath by a band like an architrave. The spandrels of arches are decorated by round disks or medallions. Magnificent ornaments of this kind in the Early Renaissance were composed of sculptured terra cotta reliefs enamelled in colors (Luca della Robbia). The simple and conventional coloring required by technical processes and the fresh and permanent lustre of the colors in contrast with the dead tones of the bricks lend a peculiar charm to this mode of decoration, so that for this purpose it is to be preferred to any other mode of ornamentation. An excellent effect is likewise produced by these glazed terra cottas on white stuccoed wall surfaces, when inclosed between sand stone belts.

143. Sgraffito Facades.

For decoration of surfaces of facades coated with stucco, sgraffito is especially suited by its similarity and durability (Fig. 198). This decoration may appear as a surface pattern either dark on light, light on dark, or as a hatched drawing. It harmonizes best with architectural forms when very little effect in relief is attempted, this being always slight in the process of sgraffito. Motives for these decorations are antique Grecian vase paintings, where within the outlines of figures only simple lines are used to separate different parts, the entire figures being then made prominent in light on dark or conversely.

Decoration of an entire facade by tapestry-like patterns is justifiable only in special cases. When two lower stories are composed of light arcades, like the Doge's palace in Venice, a high enclosed upper story above them can only be made endurable by giving the enclosing walls the greatest

[illegible] struction between vertical posts at the angles. It is evident that no projections of any kind can crown such a wall, only a light ornamental heading; architraves of the windows may likewise merely consist of delicate and lace-like borders with low relief. It does not seem proper to decorate wall surfaces of a facade by tapestry patterns, when it has massive belts, cornices, and jutting architraves. Cornices and enclosing mouldings always require a background corresponding to their own character, and when of massive forms, the solidity of the wall must be visibly expressed.

§ 24. Employment of Colonnades.

[illegible] belts and cornices. The base connects the wall with the ground; the entablature terminates it at top. But both forms are merely borrowed [illegible] below the base, which in itself terminates. [illegible] of facades are those, where the mass and weight of the wall masses appear overpowered by forms, which represent vertical aspiration and growth and compose [illegible] an ideal facade with a tasteful distribution of loads and of supports, of aspiring and of crowning dominant forms. The facade becomes the home of the plastic art, where the colonnade exhibits this idea in the purest and most ideal form. (Fig. 190). The columnar construction is transferred to the wall surface in relief and is combined with other esthetic forms, which embody similar ideas. The representation of the structurally jointed and horizontally coursed mass of the wall disappears; we see a facade in esthetic forms, which originated in another material, have been conventionalized to suit stone, but represent a lighter construction treated on ideal artistic principles. A wealth of forms may be developed on the elevation in an organic way, which far excels that of earlier forms of facades. Since the [illegible] les may easily be combined with it, even if they no longer belong to the organism of the facade. Such types of facades easily keep within limits of great simplicity, and thus preserve severity and earnestness of actual structural forms. [illegible]

[illegible] of forms.

apparent lightness, these being externally treated as tapestry patterns stretched between vertical posts at the angles. It is evident that no entablature of any kind can crown such a wall, only a light ornamental head-band. Architraves of the windows may likewise merely consist of delicate and band-like borders without relief. It does not seem proper to decorate wall surfaces of a facade by tapestry patterns, when it has massive belts, cornices, and window architraves. Cornices and enclosing mouldings always require a background corresponding to their own character, and when of massive forms, the solidity of the wall must be visibly expressed.

144. Employment of Colonnades.

In forms of facades so far considered, the enclosing wall appears as a neutral surface, serving as a back ground for architraves and merely subdivided by belts and cornices. The base connects the wall with the ground; the entablature terminates it at top; but both forms are merely borders above and below the mass, which is itself inanimate. As the last step in treatment of facades are those, where the mass and weight of the wall masses appear overpowered by forms, which represent vertical aspiration and growth and compose an organically animated structure. Mediaeval architecture emphasizes only vertical aspiration and allows this to repeat itself upwards in forms, ever becoming more delicate. But Antique Architecture and the Renaissance create an ideal facade with a harmonious alteration of loads and of supports, of aspiring and of crowning dominant forms. The facade borrows the forms of temple architecture, where the colonnade exhibits this idea in the purest and most ideal form. (Fig. 199). The columnar construction is transferred to the wall surface in relief and is combined with other esthetic forms, which embody similar ideas. The representation of the structurally jointed and horizontally coursed mass of the wall dissapears; we see a facade in esthetic forms, which orginated in another material, have been conventionalized to suit stone, but represent a lighter construction treated on ideal architectural principles. A wealth of forms may be developed on the elevation in an organic way, which far excels that of earlier forms of facades. Since the entire structure posses an ornamental character, other decorative accessories may easily be combined with it, even if they no longer belong to the organism of the facade. Such types of facades easily keep within limits of great simplicity, and thus preserve severity and earnestness of actual structural forms. Yet it is natural for decorative columnar and pilaster architecture to assume a light and graceful character, then producing significant effect by its wealth of forms.

In the composition of the facade, the decorative architecture is usually placed above a high substructure with bold jointing. Yet this may consist

of a stepped base directly supporting a series of pilasters or columns. In applying columnar orders to ornamental architecture of facades, two principal types are distinguished. Several orders are placed above each other and correspond to stories (Fig. 200), or a single colossal order is employed with the division into stories treated in a subordinate manner.

Facades of the first kind occur with even four orders above each other; but as in the following examples, a facade is properly and organically treated with two orders only. Pilasters are preferable to engaged columns, since they unite better with the wall surfaces and require a less projection of the entablature above them. The greatest difficulty is to produce a united treatment of the facade, so as to not produce an impression of two structures placed on each other, but to appear as a single structure, commencing with the substructure and terminating with the crowning entablature. The entablature of the lower order is considered and treated as a belt course, that of the upper order being the crowning entablature of the facade. The former has a simple form and slight projection; for the latter it is necessary to develop the frieze with high consoles, which permits strong projection of the upper portion without making it oppressively heavy (Fig. 201). The consoles in the frieze support a strong slab on which rest modillions that support the cornice. To give the upper order a lighter appearance, it is made one-fifth to one-fourth less in height than the lower one.

Pilasters or engaged columns are generally placed on pedestals; the lower order stands on a massive projecting substructure, and its pedestals have the usual subdivision and projection. But the bases and pedestals of the upper order may not project far, since the unity of the facade would then be broken by the width of these forms. Therefore these parts should have profiles of slight projection, being seen from beneath. A combination of plinth, scotia, and torus is suitable for bases of pilasters. The width of die of pedestal, and that of base of pilaster, should not exceed that of lower pilaster. Thus in spite of the slight projection of its base and its diminished height, the upper pilaster appears slender in comparison with the lower one.. To place a third order above the upper one and under the same conditions would not be possible, because it would be too weak a form, quite unsuited to recieve a crowning entablature adapted to the entire building.

The pilasters are usually so arranged that one pilaster is placed between two windows. The angle is strengthened by two pilasters. Windows of the principal story are larger and richer than those of the upper story. Their general forms are to be harmonized with spaces enclosed between pilasters. Different forms are employed; round-arched windows and angular pediments

produce a good effect in contrast with horizontal belts and cornices. When windows are not closely [illegible], it appears proper to decorate the upper story by pilasters and give it the effect of a gallery. The pediment-architraves of windows of the principal story form an effective contrast with such an upper story with simple forms of [illegible] between the pilasters. But the [illegible] is best to extend the lower rusticated masonry of the high [illegible] the pi- [illegible]

[illegible] front [illegible] wall surface.

b. [illegible]

[illegible] an imposing impression, it may have engaged or free columns in two stories (Fig. [illegible]), but it must then abandon a severe organism in the facade. Between the columns are to be placed the windows or arched openings with archivolts, [illegible] quite greater projection [illegible]. The upper [illegible] of windows [illegible] rest on small columns doubled in depth and with plain piers behind them. [illegible]

[illegible] the columns are [illegible] at least half their upper diameter, since the keystone of the arch would otherwise require too great projection. [illegible] differentiation [illegible] of the principal [illegible] [illegible] should terminate the facade in an effective horizontal line corresponding to [illegible] are placed on a high frieze [illegible] support a massive straight [illegible] on which the cornice rests. In order to avoid [illegible], especially in case of free columns, the [illegible] of the [illegible] at the [illegible], the [illegible] extend to this and are carried across it as plain [illegible]

In accordance with the requirements of the upper portions, such a facade requires a substructure with strong forms and bold masonry. It [illegible] demands a strongly projecting base with large forms and a heavy [illegible] with which [illegible] for a continuous balustrade and forms an extended balcony in front of the principal story. Magnificent examples of this kind are found in later Venetian facades, e.g. [illegible] Pesaro and [illegible] palaces in Venice.

2nd. Use of a Single Colossal Order.

With a single order, a united and grand treatment of facade is possible [illegible]

produce a good effect in contrast with horizontal belts and cornices. When windows are set closer, it appears proper to decorate the upper story by pilasters and give it the effect of a gallery. The pediment-architraves of windows of the principal story form an effective contrast with such an upper story with simple forms of windows between the pilasters. For the angle, it is best to extend the lower rusticated masonry of the angle up beside the pilasters to the architrave as a pier, either plain or with flat bosses. By the projection of the upper pilasters, the upper wall surface must be set back from the lower wall surface.

145. Use of Engaged and Free Columns.

If the treatment of the facade must produce an effect of strong relief and an imposing impression, it may have engaged or free columns in two stories (Fig. 202); bu t we must then abandon a severe organism in the facade. Between the columns are to be placed the windows as arched openings with archivolts, their keystones supporting the entablature. To suit this purpose, these require greater projection and caps. The impost caps of window arches may rest on small columns doubled in depth and with plain piers beside them. The columns then act as structural members and all forms of the order must recieve their normal development. For free columns, it is necessary to break the entablature around them by at least half their upper diameter, since the keystone of the arch would otherwise require too great projection. Special difficulties arise in the treatment of the principal entablature, to crown the structure without burdening the upper order by its oppressiveness. This should terminate the facade in an unbroken horizontal line corresponding to the straight substructure. To fulfil these requirements, pier-like consoles are placed in a high frieze over each column and support a massive straight slab extending the entire length, on which the cornice rests. In order to avoid an unquiet outline at the angle, especially in case of free columns, the wall mass of the facade may project at the side as a wall pier; the various belt courses then extend to this and are carried across it as plain bands.

In accordance with the massiveness of the upper portions, such a facade requires a substructure with strong forms and bold masonry. It especially demands a strongly projecting base with large forms and a heavy cap with thick band, which has a continuous balustrade and forms an extended balcony in front of the principal story. Magnificent examples of this kind are found in later Venetian facades, especially of Pesaro and Rezzonico palaces by Longhena.

146. Use of a Single Colossal Order.

With a single order, a united and grand treatment of facade is possible with severe organic forms; yet this type of facade introduces conditions,

which can generally be fulfilled only in palaces (Fig.203) and public buildings. To the dignified effect of the exterior must correspond the treatment of the interior. With such an order may be combined only a larger and a smaller story, so that it always produces the appearance of a great room extending through both, merely divided by a gallery. But if several stories with the usual window openings are to be combined with a single colossal order of engaged columns or pilasters, it would be easy to produce the effect of a previously existing colonnade, walled up later. The small details of window architraves are there in striking disproportion to the great details of the colossal order.

With grandeur of the facade must be contrasted strength and simplicity of substructure or ground story. Rusticated work is appropriate, either continuous, or only on piers beneath the pilasters or half columns, above this being a massive unbroken belt course. The substructure may also be opened as an arched portico when this is entirely finished in rusticated work. Pilasters or engaged columns may stand directly on the belt-course; they are generally placed on pedestals of the same height as the window sills. Pedestals recieve a flat band of the width of the window sill; this would appear too weak beneath the massive bases.

The main division of surface between the pilasters or engaged columns should not be made below the upper third of its height. A delicate belt course with a broad band beneath is appropriate for this. The lower surface is therefore generally suited to a harmonious treatment of the windows. The projection of the finish of the windows depends on whether pilasters or engaged columns are placed beside them. With pilasters projecting one-sixth to one-fifth their width, the window finish if composed of engaged columns supporting pediments, may project very strongly, and pilasters may project still more. But between engaged columns and in recessed niche-like spaces, only the pediment can have a good effect in dividing the surface, with a balcony or panel below the window, set in a line with the bases of columns or pilasters; a strong projection of window finish would fill ip the space too much and make it appear unquiet. Corinthian pilasters are best accompanied by narrow and plain wall strips beside them, which also extend along beneath the architrave in the same width, chiefly to detach base and capital from wall surface and to widen the slender and fluted pilaster to form a wall pier.

Since pilasters or engaged columns stand on a high substructure, the entablature in the ordinary form appears too small as a dominant member in contrast therewith, and it therefore requires a balustrade above, or an attic (Fig.204) which may contain the windows of an upper story. Such a crowning member is always to be placed on a high base in order to make it visible above the prin-

[illegible] The [illegible] of the facade are [illegible] with [illegible], [illegible] with [illegible]. With [illegible] at [illegible]

[illegible]

[illegible] which [illegible]

[illegible] of a [illegible]

[illegible] for details of special parts of the facade. [illegible] the first [illegible], the [illegible] and [illegible] by a [illegible]. The [illegible] are [illegible] connected with the wall if they [illegible] connected with the masonry, especially in [illegible] work. [illegible] of [illegible] wooden [illegible] effect [illegible] to avoid a [illegible]

[illegible] may be [illegible] on the order of [illegible]. The [illegible] or enclosed [illegible] on a balcony. It should be light, and [illegible] and constructed with architectural forms, having small columns or pinnacles at the angles [illegible] with the architecture of the [illegible] is only [illegible] to [illegible] through two stories if [illegible] together in the treatment of the facade.

[illegible]

[illegible] point for the horizontal [illegible] of the structure. By a [illegible]

[illegible] in accordance with the [illegible]

[illegible] axis [illegible] for the [illegible], as may [illegible] axis of symmetry in the [illegible] of all [illegible]; for the [illegible], this only occurs in an entrance or principal [illegible]. A [illegible] and the [illegible] the centre, while [illegible]

[illegible] buildings.

[illegible] residences. An [illegible] always [illegible] to emphasize the axis of symmetry [illegible] of the [illegible]. This [illegible] may be increased by [illegible] a balcony over the portal. [illegible] in grouping the windows, employing [illegible] larger group [illegible] three or five windows, and [illegible]

cipal entablature. The angles of the facade are treated with piers, doubled pilasters, or pilasters with engaged columns. With a series of colossal pilasters or columns, two-story or one-story parts are easily combined. For in the central portion of the facade, round arched windows may occupy the height of the entire order; the impost moulding may be extended to the wings as the window sill of a subordinate upper story.

147. Balconies and Bay Windows.

Balconies and bay windows remain for mention as special parts of the facade. The balcony is usually placed before the first upper story, the belt course projecting above consoles, and it is enclosed by a balustrade. The corbels are organically connected with the wall if they spring from prismatic blocks connected with the masonry, especially in rusticated work. The balustrade may consist of perforated slabs imitating wooden lattice after the antique, or of balusters between the angle pedestals. In order to avoid a heavy appearance, these angle pedestals should be as narrow as possible; they may be strengthened on two sides by half balusters. The bay window is really an enclosed structure on a balcony. It should be light, and graceful, and constructed with architectural forms, having small columns or pilasters at the angles. Harmony with the architecture of the wall is only to be attempted in its heights. A bay window may extend through two stories if these are combined together in the treatment of the facade.

b. Horizontal Subdivision of the Facade.

148. Detached Buildings.

The centre of the building or vertical axis of symmetry is taken as a starting point for the horizontal subdivision of the structure. By a balanced arrangement of parts about the centre and by its symmetry, the structure appears as if entirely complete in itself. If the building consists of a uniform mass, it is first to be decided in accordance with the interior, whether this is to be arranged about a central vertical axis or a horizontal axis. For the first, we may commence at a central axis of symmetry in the treatment of all facades; for the last, this only occurs on an entrance or principal facade. A pediment and the portal mark the centre, while treatment of the sides expresses the sequence of internal apartments or divisions.

149. Facades between Adjoining Buildings.

Special consideration is required by facades built between other structures, as usual in city residences. An endeavor always prevails to emphasize the axis of symmetry by treatment of the portal. This accenting of the centre may be increased by placing a balcony over the portal. Another symmetrical arrangement consists in grouping the windows, employing similar forms. A larger group comprises three or five windows, and may be separated by spac-

es from side groups or single windows on each side. The central group may become a complete loggia. To mark a clear division in groups, decoration of the stories by pilasters or columns is especially appropriate. Single supports may either indicate this division, or these may be set in pairs to terminate the wings and to separate them from the middle portion, while spaces for the windows are subdivided. (Fig. 205).

It frequently suits the division into rooms to place the chief entrance at one side of the facade instead of at the centre. To then obtain an axis of symmetry, it is unnecessary to repeat at the other side the doorway as a useless form. It is far better to emphasize the centre by a group of windows and balcony or bay window, balancing the doorway by a larger window. But for a door with a simple architrave, this is not at all necessary. Instead of the centre only, both wings might be accented by balconies or bay windows. Lack of symmetry with a door at one side is then easily compensated, and this may even lend to the facade a certain grace.

150. Buildings with Rooms of Unusual Height.

If a building contains rooms of unusual height, then for an organic treatment of plan and facade, larger rooms may be placed at the centre and subordinate ones in the wings. If the height of apartments in central portion equals a two-story arrangement in the wings, a common entablature may then extend over the entire facade. A slight projection of the central portion is always best, to emphasize its importance. A series of colossal pilasters or columns is suitable for combining the two stories at the sides with the great windows of the central portion in a single organism. The upper arrangement may be repeated in the substructure, so that the great windows of the central part correspond to great openings for portals, and the wings in two stories to the superposition of ground and mezzanine stories.

To produce an effective outline it is best to treat the central part as a separate architectural mass, making this higher than the wings (Fig. 206). It then recieves a richer treatment than the latter and has larger forms. For the central portion, a columnar architecture with great arched windows, a free colonnade with pediment above, or compositions like triumphal arches are suitable. For contrast with the more open middle portion, the wings recieve broader surfaces and more simple arrangement of pilasters. A great exaedra or niche covered by half dome is sometimes a very effective form for the central part, or a portico covered by a tunnel vault. These forms require massive piers at each side, treated with pilasters or columns, the lower order supporting the impost moulding, the higher one supporting the entablature. Surfaces between them may have small niches with statues, etc. Such a central structure requires an attic above the main entablature, which may be a

pediment, or decorative sculpture (symmetrically arranged groups of figures, quadriga, etc.).

If such a building stands on a high substructure or basement, this should have uniform coursing and treatment to form a common base for the upper portion. At its centre will be a great portal, or an external staircase to the upper story. With a raised and projecting central portion, the wings should not be made too short, to not appear too insignificant in dimensions, or be entirely concealed by the central part if viewed obliquely. Hence slight projection of the central part is recommended, about one-sixth to one-fourth its width; the wings will be in good proportion if their lengths approximately equal this. With greater length of wings, it is proper to add to them special angle pavilions (towers, etc.); these usually have a vertical subdivision harmonizing with the wings, and the main entablatures are at the same height; compared with the central part, their lengths must be less than their heights.

151. Arrangement of Central Mass of Building.

The richest subdivision of an architectural structure occurs, when the parts of the building are grouped along its main axis and around a high central mass. This central mass is set back from principal facade, usually flanked on both sides by courts, and requires on its upper parts a treatment calculated for being viewed at a considerable distance. A dome first requires a high and undivided substructure, to become visible from below and over the surrounding masses of the building. Decorative architectural members, like columns, pilasters, cornices, etc., should there be of smaller dimensions, than on other parts of the building, and should have the greatest simplicity of details. Central masses of rectangular plan, cubical or prismatic in form, slightly subdivided and only crowned by an entablature or pediment, moderately predominant over the principal facade. As external surfaces of separate masses, side facades should likewise be symmetrically arranged; when quite distant from the central mass of the building, correspondence to it is not necessary.

152. Irregular Grouping of Design.

For buildings with irregular surroundings or in the open country, rigidly symmetrical arrangement may be omitted if the purpose of the building suits this. Yet a central mass must always predominate over the parts, and the building must balance in its masses. One wing may have a form like a tower, the other being treated as a horizontal addition. In country houses such grouping affords a free plan and harmony with the landscape. Monumental structures with irregular grouping may have a very pleasing effect, if surroundings and the form of site give oppurtunity therefor, as at the

situations in Rome.

Chapter I. [illegible].

§ 1. General.

The essential purpose of all architectural creation is to produce rooms for the different requirements of human society (Art.97). The architectural treatment of the room is therefore placed on an equality with that of the exterior, if the building is to be a complete work of art. As in facades, so in the decorative treatment of rooms, we start from their construction. The type of ceiling or vaulting [illegible], [illegible] the walls; but the interior requires for its treatment more considerable softening from that of the exterior. Exterior architecture must acquire a [illegible] of durability and stability. This is produced by a severely [illegible] treatment where the material used in the construction appears unconcealed by the decorative form and requires uniform treatment. But in the interior, comfort, elegance, and richness, [illegible] with the construction, [illegible] responds to the intellectual needs. Forms and materials required for the construction are unsuitable for this purpose. [illegible] covering, which permits the construction to appear in lighter materials. [illegible] the decoration in combination with each other, each requiring its own technical treatment and forms. Uniformity of forms, as on the exterior of a building [illegible] themselves requiring the arrangement of special [illegible] furniture, so that the latter may appear a necessary part of the whole. [illegible] the room a strictly architectural treatment, as in buildings for divine worship, museums, [illegible] halls, etc.

A difference is always made between architectural forms used on the exterior and in the interior of a building. On the exterior, relief of forms is increased by strong light; in the interior, light is usually insufficient for clearly seeing [illegible] form or a single color; polychromatic treatment [illegible], especially in marking the outlines, and with a [illegible] and ornament. On the exterior, forms must be [illegible] a greater [illegible]

Erechtheum in Athens.

Chapter 2. Internal Architecture.

153. General.

The essential purpose of all architectural creation is to produce rooms for the different requirements of human society (Art.92). The architectural treatment of the room is therefore placed on an equality with that of the exterior, if the building is to be a complete work of art. As in facades, so in the architectural treatment of rooms, we start from their construction. The form of ceiling is especially determinative, since by this fixes the subdivision of the wall. But the interior requires for its treatment some essentials differing from that of the exterior. External architecture must aequire a character of durability and stability. This is produced by a severely architectural elevation where the material used in the construction appears undisguised by the decorative form and requires uniform treatment. But in the interior, comfort, elegance, and richness, attract persons; works of the sister arts of Sculpture and Painting are suitably placed therein and combine with the architecture; the entire decoration produces a harmony, which corresponds to the intellectual meaning. Forms and materials required for the construction are unsuitable for this purpose. Strong and earnest forms on the exterior appear heavy and rude in the interior. The room requires a decorative covering, which permits the construction to appear in better materials, made attractive by artistic treatment and coloring, or an independent lighter ideal construction is executed. Thus different materials appear in the decoration in combination with each other, each requiring its own technical treatment and forms. Uniformity in forms, as on the exterior of a building of uniform materials, cannot usually appear in the interior. The room serves purposes more or less material, themselves requiring the arrangement of special furniture. The internal architecture must combine with this furniture, so that the latter may appear a necessary part of the whole. Rising above purely material purposes, the possibility increases for giving the room a strictly architectural treatment, as in buildings for divine worship, museums, city halls, etc.

A difference is always made between architectural forms used on the exterior and in the interior of a building. On the exterior, relief of forms is increased by direct light, in the interior, light is usually insufficient for clearly seeing a form of a single color; polychromatic treatment must therefore aid us, especially in marking the outlines, and with a difference of color between background and ornament. On the exterior, forms must be designed for being seen from a greater distance and a direct view, therefore having a bolder and more massive character. But in the interior, they are

only viewed near at hand, chiefly obliquely from beneath; their profiling must therefore be more refined, details more delicate and intended to be seen from below.

The kind of ceiling permits forms of rooms to be divided into two classes, those with horizontal ceilings, andthose with vaults. In the first are considered various methods of covering the walls and of treating the ceiling; in the second, modes of subdividing rooms and the decorations suitable for different forms of vaults.

a. Rooms with Horizontal Ceilings.

154. Base and Cornice of Wall.

Horizontal ceilings exert only vertical pressure on the walls, which then only require thickness sufficient for this pressure and for their own stability. The treatment of the wall may then be uniform, or it may be replaced by a colonnade or arcade, or be pierced by doors and windows, so long as parts above these openings are able to support their loads. Every treatment for walls must first have at bottom a base connecting them with the floor, and a cornice at top. The base usually changes into the lower wall wainscoting of hard materials, a dado or paneling, which must be durable, as the lower part of the wall is exposed to injury. Stone and wood are suitable materials for this covering. Lining with stone slabs is especially appropriate with antique wall decorations. Stone slabs of rectangular form are then fixed above the base mouldings and are bordered at top by a flat band or belt-course. Wooden paneling also takes a special form at the base, and requires framework and rectangular panels. A moulded cap at top with a slightly projecting rounded profile forms a transition to the middle wall surface.

The surface of the wall require forms above it to both crown it and make a transition to the ceiling. The cornice belongs to the wall covering and has a frieze with ascending ornaments or figures. The cornice is the transition to the horizontal ceiling, and to express its function as a bearing form, it must appear as a course structurally united with the wall and corbelled out from it.

155. Wall Tapestries.

In the decoration of wall surfaces, their function is enclosing the room should chiefly be expressed. Ornamental forms are therefore borrowed from the oldest form of enclosure, merely an inclosing by suspended tapestries. Since the wall is built of solid materials, a covering of tapestry formed the wall decoration during many periods of civilization. In the Graeco-Roman period, these tapestries with inwrought or painted figures played the chief part in the decoration of walls. During the entire Renaissance period, cost-

ly wall tapestries were used for churches and palaces on festal [illegible] technical skill has now substituted cheaper manufacturing processes for the hand work, and has invented various substitutes for the costly wall tapestries, and these have been very extensively used in consequence of their cheapness.

[illegible] will appear [illegible] decorated according to antique and Renaissance ideas, it should have within a wide border representations of figures or landscapes, all designed on architectural principles. In the decoration of tapestry by the first method, it is important that this should be based on an easily [illegible] the vertical [illegible] yet these forms must not be enclosed by geometrical lines, but be represented by [illegible] which in their general effect produce the geometrical form. Such a surface pattern is appropriate when the wall forms a background for movable objects. The decoration of the wall must then be subordinate to the objects before it, as a background, it must have a quiet and full tone and [illegible] different parts of the design no great diversity in color. A good effect may be obtained by patterns, where design and ground are in the same color tone, differing only in degree of depth. Tapestries with ornamental figures (Fig. 237) are used for enclosed spaces, and must [illegible] suited to the wall surfaces to be decorated. The corners and centre of such border are emphasized by small panels with little figures, medallions, etc. Figures and landscapes are used in picturesque compositions.

A purely ornamental expression must be arranged so that these are appropriate [illegible] by a large ornament, or by a graceful shrine with a figure, by a small statue, etc., whose enclosure combines with the other decoration. Shields, medallions, vases, etc., may also form centres of the ornamentation, which [illegible] Italian tapestries the ornament of border is usually dark on light ground, and conversely the decoration of the surface is light on dark ground; for [illegible] ground.

156. Mural Painting.

Painting walls is directly compared with covering them by tapestries; old- [illegible]

Each representation in tapestry has acquired a conventionalized form and combination of colors, so that the surface is never disturbed, and this always

ly wall tapestries were preferred for churches and palaces on festal occasions. Perfected technical skill has now substituted cheaper manufacturing processes for earlier hand work, and has invented various substitutes for the costly wall tapestries, and these have been very extensively used in consequence of their cheapness.

In accordance with oriental traditions, wall tapestry has a uniformly repeated ornament or morive, but according to antique and Renaissance ideas, it should have within a wide border representations of figures or landscapes, or be designed on architectural principles. In the decoration of tapestry by the first method, it is important that this should be based on an easily recognizable geometrical form, like vertical stripes, squares, polygons, etc. Yet these forms must not be enclosed by geometrical lines, but be represented by ornamental shapes, which in their general effect produce the geometrical form. Such a surface pattern is appropriate when the wall forms a background for movable objects. The decoration of the wall must then be subordinate to objects before it; as a background, it must have a quiet and full tone and exhibit in different parts of the design no great diversity in color. A good effect may be obtained by patterns, where design and ground are kept in the same color tone, differing only in degree of depth. Tapestries with ornamental figures (Fig. 207) are used for enclosed spaces, and must therefore be suited for the wall surfaces to be decorated. The corners and centre of each border are emphasized by small panels with little figures, medallions, etc. Figures and landscapes are used in picturesque composition,

a purely ornamental expression must be arranged so that clear and appropriatedivision of surfaces and masses may result. The centre is always occupied by a large ornament, as by a graceful shrine with a figure, by a small statue, etc., whose enclosure combines with the other decoration. Shields, medallions, vases, etc., may also form centres of the ornamentation, which covers the surface with slender candelabra, arabesques, and festoons. The border should decidedly ride from the panel surface in its color tone. In Italian tapestries the ornament of border is usually dark on light ground, and conversely the decoration of the surface is light on dark ground; for French tapestries, the border is mostly dark with surface ornament on light ground.

158. Mural Painting.

Painting walls is directly connected with covering them by tapestries; older forms directly imitate the latter, and in its later development, the important laws of style borrowed from wall tapestries are strictly retained.

Each representation in tapestry has acquired a conventionalized form and combination of colors, so that the surface is never disguised, and this always

appears as a covering. Thus conventional wall painting strives less for realistic truth to nature in figures or landscapes, than to appear as a surface decoration by severe outlines and simple broad coloring with a perfected artistic effect. Early Grecian mural paintings in temples and public halls were imperfectly imitated in paintings on vases and by the latter we may learn the severely conventionalized and decorative character of the wall paintings. Even borders of pictures on vases are not suited to the form of vase, but indicate the mode of enclosing such wall paintings, and suggest that all mural painting then firmly retained the idea of tapestry covering.

157. M Pompeian Mural Painting.

A peculiar form of decorative painting was developed in later antique art. It is usually termed "Pompeian" as it chiefly became known in the cities of Campania buried by Vesuwius, of which Pompeii was the most important. In this mode of ornamental painting there was an endeavor to subdivide the wall surface and apparently enlarge it by making a slight architectural frame-work, suspended tapestries and perspective views forming the enclosure of the room. This is to be regarded as a pleasing fancy of the imagination, rather than as an actual deception, because not a realistic imitation of actually existing objects, but a sportive representation of light and graceful forms having a purely ideal existence.

Such a decoration (Fig. 208) is usually composed as follows. The lowest part is occupied by a dado of dark or black color, subdivided by lines and bands and containing in its panels, views, fishes swimming, birds, or plants. From this base rises a light architectural structure, enclosing the larger central space, by its prespective depth frequently appearing as a kind of shrine. This enclosure has a suspended tapestry as its motive, with a ricj border and a large picture with several figures. At the sides of the middle space are narrow views with architectural forms drawn in perspective. Side panels also represent suspended tapestries within light borders and are more simply decorated, having as ornament an ascending figure or medallion on tapestry ground. The supports of the architectural frame-work are slender columns, candelabra, or reeds, recieving a correspondingly slight entablature, frequently broken and is decorated by fanciful ornaments and additions. The entire architecture appears as if designed in metal ard is usually of a golden color; deep red is preferred for the suspended tapestry, though other colors were likewise employed. Above the portion of the wall already described is a deep frieze, usually treated as if transparent. Upon the cap of the base stand shrines, candelabra, and slender hermes columns, which partly continue the lower subdivision of the wall, and are partly the upper termination of the wall surfaces, connected by light

[illegible], [illegible] and [illegible]. The slight architecture of this transparent [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible]. [illegible] upon [illegible] the [illegible] of perspective [illegible] all [illegible], but [illegible] a [illegible] observer; the various parts are drawn with different points of sight. This wall decoration apparently enlarges small rooms [illegible] the [illegible] and by the views, but it requires the walls to be [illegible], and when our custom of [illegible] living rooms [illegible] [illegible] to [illegible] [illegible].

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] were [illegible] in [illegible] the [illegible]. [illegible] [illegible] and [illegible] [illegible] [illegible] [illegible] [illegible], the [illegible] of [illegible] of walls and the ornamental forms of antique wall decoration [illegible] as [illegible] as possible. [illegible] [illegible] [illegible] [illegible] in the [illegible] house of [illegible] [illegible] the [illegible] of [illegible]. [illegible] [illegible] was [illegible] of [illegible] [illegible] in architecture, though they were [illegible]. [illegible] [illegible] of [illegible] was also later very influential [illegible] mural painting. Architecture was replaced by a free structure with ornamental forms, [illegible] by the most varied accessory figures.

[illegible]. [illegible] [illegible].

Covering walls with wainscoting occurred in the earliest antiquity in [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] mode of covering walls. [illegible] of dwellings scarcely permit us [illegible] on [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] say anything on this point, but during the Middle Ages [illegible] [illegible] of the [illegible], wainscoting was extensively used in houses, monasteries, and [illegible]. In the [illegible] and [illegible] centuries joinery was [illegible] [illegible] carpentry, and wainscoting changed from joining together [illegible] [illegible] boards to a framework with inserted panels. In the Renaissance period, [illegible] [illegible] for wainscoting, especially in [illegible], [illegible] [illegible] [illegible] in [illegible], [illegible], and apartments of [illegible]. [illegible] [illegible] developed forms of panelling were transmitted to [illegible] [illegible] and to France, assuming a national character in both places.

In constructing wainscoting, peculiarities of wood must be considered. It changes [illegible] in length, but [illegible] continually varies in [illegible] [illegible] [illegible]. This requires the construction of a framework of small width with [illegible] panels, which can move slightly within their grooves. The frame is [illegible] composed of [illegible] pieces, so that when [illegible], [illegible] or moulding may be [illegible] in [illegible] separate pieces.

The wainscoting of the wall is [illegible] divided in [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], and the [illegible] [illegible] [illegible] [illegible]

festoons, bands and arabesques. The slight architecture of this transparent frieze is ornamented by dancing figures, winged genii, and fanciful beings of all kinds. Panels and open spaces are shown in perspective and do not at all harmonize, but relate to a near observer; the various parts are drawn with different points of sight. This wall decoration apparently enlarges small rooms by the gracefulness of its forms and by its views; but it requires the walls to be entirely unbroken, and with our custom of filling living rooms with furniture it is applicable in only few cases.

The Renaissance made no extensive use of mural painting as Roman antiquity as tapestries were preferred in decorating the finest apartments. When in the 15th and 16th centuries walls were ornamented by decorative painting, the modes of subdivision of walls and the ornamental forms of antique wall decorations were employed as far as possible. Favorite motives were the paintings in the Golden House of Nero beneath the Baths of Titus. Moderate use was made of perspective recesses in architecture, though they were correctly represented. Ornamental treatment of tapestries was also later very influential in mural painting. Architecture was replaced by a free structure with ornamental forms, animated by the most varied acessory figures.

158. Wooden Wainscoting.

Covering walls with wainscoting occurred in the earliest antiquity in Phoenicia. Bibical narratives of the building of Solomon's Temple and Palace are equally applicable to Phoenician architecture. Classic antiquity seldom used this mode of covering walls. Remains of dwellings scarcely permit us anywhere to assume wooden paneling, nor do ancient writers say anything on this point. But during the Middle Ages and north of the Alps, wainscoting was extensively used in houses, monasteries, and castles. In the 14th and 15th centuries joinery was separated from carpentry, and wainscoting changed from joining together narrow matched boards to a framework with inserted panels. In the Renaissance period, preference existed for wainscoting, especially in Upper Italy, shown by fine examples in sacristies, choirs, and apartments of palaces. Rich and finely developed forms of paneling were transmitted to Southern Germany and to France, assuming a national character in both places.

In constructing wainscoting, peculiarities of wood must be considered. It changes slightly in length, but its width continually varies in damp or dry air. This requires the construction of a framework of small width with inserted panels, which can move slightly within their spaces. The frame is frequently composed of doubled pieces, so that when wide, shrinking or swelling may be possible in its separate pieces.

The wainscoting of the wall is usually divided in two parts in height, a base with oblong horizontal panels, and the wainscoting proper with its high

panels. The lower portion is of simple form, but has a [illegible] [illegible] upper portion may have ornamental pilasters or engaged columns between panels to support the cornice of the wall. (Fig. [illegible]). In accordance with the smaller scale, the forms of the columnar orders are simplified and have small and slender shapes, so as to appear sufficiently prominent in the dark color of the wood. [illegible] dentil bands have especially good effect; the leaf moulding is excellent [illegible]

Inlaid work or intarsia in wood is a favorite method for decorating panels. The use of veneers in different colors has the best effect in flat ornament of the Renaissance. The Italian Renaissance understood how to fill each surface in great variety with ornaments of beautiful and pleasing form. [illegible] which are [illegible] the principal masses of ornament, [illegible] and small figures, in a regular way. This produces a clear composition [illegible] leaf mouldings or egg-and-dart mouldings enclose them; the narrow [illegible] surfaces are sunken with a narrow border and decorated by carved ornament. [illegible]

The German Renaissance received from Italy only the columnar orders of the [illegible] them with existing native forms, partly executing them in the same spirit with new forms in bold relief. The ornament is ruder than that of Italian and is frequently composed of carved and perforated cartouches and metal-work. [illegible] like metal work, but the upper part is left smooth. The pilasters have a new form, borrowed from furniture, being diminished downwards with [illegible]

panels. The lower portion is of simple form, but has a separate base as a wide band and a cap, which projects little and has a rounded profile. The upper portion may have ornamental pilasters or engaged columns between panels to support the cornice of the wall. (Fig. 209). In accordance with the smaller scale, the forms of the columnar orders are simplified and have sharp and angular shapes, so as to appear sufficiently prominent in the dark color of the wood. Among decorated mouldings, the large egg-and-dart moulding and delicate dentil bands have especially good effect; the leaf moulding is executed with simple incisions. Besides pilasters, the panels are decorated by enclosing bands, with a leaf moulding inside.

Inlaid work or intarsia in wood is a favorite method for decorating panels The use of veneers in different colors has the best effect in flat ornament for the intarsia. The Italian Renaissance understood how tc fill each surface in great variety with ornaments of beautiful and pleasing form. Most ornament consists of conventionally treated plant forms, growing upwards from a vase or candelabrum, and extending in beautifully curved scrolls. The centre of the surface is marked by a plate, shield, or similar object, around which are grouped the principal masses of ornament, of interlaced motives, and small figures, in a regular way. This produces a clear composition with alternation of broad and delicate forms. In contrast to flat ornament of the panels, the framework may be decorated by bold sculptured ornaments. Leaf mouldings or egg-and-dart mouldings enclose them; the narrow surrounding frame has an interwoven band in low relief; pilasters are fluted, or their surfaces are sunken within a narrow border and decorated by carved ornament. The frieze of the entablature is also an appropriate place for relief ornament.

The German Renaissance recieved from Italy only the columnar orders of the High Renaissance Period. It employed these in its own way, partly combining them with existing native forms, partly extending them in the same spirit with new forms in bold relief. The ornament is ruder than that of Italian and is frequently composed of carved and perforated cartouches and metal-work. The lower third of pilasters and engaged columns is usually decorated by ornament like metal work, but the upper part is left smooth. The pilasters took a new form, borrowed from furniture, being diminished downwards with bold band-like ornament forms below its middle 9(Fig. 210). Such supports were also placed on elegant pedestals above the base of the wall. The pilaster recieves as background a wall-strip having the width of its extreme projections. The frieze of the entablature generaldy has consoles supporting the widely projecting and delicately profiled cornice. The panelling of the walls is treated in the most varied ways and boldly framed. Motives of the panels are

[illegible]
[illegible]
usually dark and consist of better woods, panels being light with a ground of beautiful grain.

Wooden paneling does not usually occupy the entire height of the wall, but leaves a deep unbroken frieze at top, decorated by painting or covered by [illegible]. When the paneling covers the entire wall, paintings on wood panels or canvas are properly inserted in its upper portion instead of wooden panels. Partial gilding of the wood is necessary to set off deep and full colors of oil paintings, especially in the framework. Then intarsias also occur in the panels between the pictures and the base.

229. Marble Wainscoting.

Covering the wall with marble slabs succeeds wooden paneling for its better appearance. Even if a framework with panels is not formed, harmony of colors requires the larger slabs of varied coloring to be enclosed by bands of [illegible] in color. The method of fixing such wall covering in place makes this arrangement suitable, large slabs being fixed by cramps sunk in their edges, the narrow bands being cemented in between them. Outer surfaces of slabs, of inlaid portions and of bands, are usually set in the same plane, because they may then be polished together. Only such bands [illegible]
[illegible]
[illegible]
colors, to heighten this coloring. Slabs, when veined in various colors, are [illegible]
[illegible]
bases, and cornices, when executed in white marble with some gilding produce splendid effect.

[illegible]
ed use in Alexandrian and Roman periods. Such decorations are imitated in [illegible]
[illegible]
in covering walls. The covering of the lower part of the wall in the interior of the Pantheon remains from this era. In Early Christian and Byzantine periods, churches were veneered in the antique manner with marbles of differ-
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

woods of handsome color, flat niches, arched panels with inlaid ornament, etc. Bold contrasts of color were sought in the paneling; structural portions are usually dark and consist of better woods, panels being light with a ground of beautiful grain.

Wooden paneling does not usually occupy the entire height of the wall, but leaves a deep unbroken frieze at top, decorated by painting or covered by painting tapestry. When the paneling covers the entire wall, paintings on wood panels or canvas are properly inserted in its upper portion instead of wooden panels. Partial gilding of the wood is necessary to set off deep and full colors of oil paintings, especially in the framework. Then intarsias also occur in the panels between the pictures and the base.

159. Marble Wainscoting.

Covering the wall with marble slabs succeeds wooden paneling for its better appearance. Even if a framework with panels is not formed, harmony of colors requires the larger slabs of varied coloring to be enclosed by bands of quiet tone and usually dark in color. The method of fixing this wall covering in place makes this arrangement suitable, large slabs being fixed by cramps sunk in their edges, the narrow bands being cemented in between them. Outer surface of slabs, of inlaid portions and of bands, are usually set in the same plane, because they may then be polished together. Only such bands project, which are to produce an architectural subdivision of the wall, and these recieve a corresponding profile. Since most kinds of marble have strongly broken tones of color, it is necessary to arrange them in complementary colors, to heighten this coloring. Slabs, when veined in various colors, are separated from enclosing parts by white lines, that the eye may distinctly separate the colors. Variegated marble, sculptured members, like capitals, bases, and cornices, when executed in white marble with some gilding produce splendid effect.

Marble wainscoting (Fig.211)found its richest development and most extended use in Alexdrian and Roman periods. Such decorations are imitated in Pompeian paintings (Temple of Jupiter, Basilica, Older Houses). According to Roman authors, luxury was carried to a high point under the earlier Caesars in covering walls. The covering of the lower part of the wall in the interior of the Pantheon remains from this era. In Early Christian and Byzantine periods, churches were veneered in the antique manner with marbles of different colors, mostly taken from ancient monuments; yet the broad surfaces of the antique wainscoting frequently give place to mosaics. The Renaissance invented imitation of genuine marble in stucco marble, which required much time and labor, but which is sometimes preferred for its uniform texture to real marble, where some veins are usually soft. The later Renaissance employ-

ed this stucco walls; formerly, especially in Jesuit churches, and treated [illegible]. Together with [illegible] leaves, these [illegible] be much used now, and properly so for decorating entrance halls, stairways and state apartments.

271. Treatment of Ceiling.

Treatment of the ceiling is generally independent of that of the walls, and in the best examples of the different art epochs the most diverse forms of ceilings occur with the different modes of treating walls. The ceiling may either have the construction visible and treated ornamentally, or it may be entirely concealed and covered by a decorative form, like an ideal structure of framework or a suspended awning or netting, which transforms the ceiling into [illegible], freely soaring and beautifully subdivided forms.

272. Structural Ceiling with Wooden Beams.

The simplest structural form of ceiling consists of uniformly spaced beams covered by a floor of boards. The antique ceiling of stone beams is merely a translation of a wooden beam ceiling into stone. Pompeian paintings prove that the wooden beam ceilings of antiquity have their structural elements left visible. This was the only method of covering rooms in the middle ages, and such ceilings were richly carved and gilded for state apartments. In the earlier renaissance period, this was ornamentally treated in the new form of the style; but from the 16th century, it was supplanted by the various forms of panels.

Decorative treatment of such a ceiling (Fig. [illegible]) consists in giving prominence to the functions of the different parts. The beams support the roof and their lower surfaces are ornamented by stretched bands or interlaced work, to make prominent the horizontal enclosing of the room. A cyma placed at the top of the walls is a symbol of the support of the ceiling above it. The latter may be subdivided in small panels by enclosing bands, each decorated by a symbol of expansion in form of a star, a rosette, or similar ornament. Beams are laid on the wall and either rest on a continuous corbel, or on corbels. The first is suitable when the wall is lined with stone, this cornice then being also of stone as a part of the wall, and treated like an entablature. For other treatment of walls, especially with tapestries or paintings on the upper part, it is sufficient if [illegible] of wood and [illegible] colors. It is proper in large rooms to rest the beams supporting the ceiling on heavy girders or main beams (Fig. [illegible]). If these are placed at moderate distances, [illegible] and the ceiling [illegible], this produces a [illegible] and highly [illegible] type of ceiling, which may be [illegible] by painting and [illegible] produces a very rich effect.

ed this stucco marble profusely, especially in Jesuit churches, and treated wall spaces with fanciful forms. Together with genuine marble, stucco marble is much used now, and properly so for decorating entrance halls, stairways and state apartments.

160. Treatment of Ceiling.

Treatment of the ceiling is generally independant of that of the walls, and in the best examples in the different art epochs the most diverse forms of ceilings occur with the different modes of treating walls. The ceiling may either have the construction visible and treated ornamentally, or it may be entirely concealed and covered by a decorative form, like an ideal structural framework or a stretched awning or netting, which transforms the ceiling into light, freely soaring and beautifully subdivided forms.

161. Structural Ceiling with Wooden Beams.

The simplest structural form of ceiling consists of uniformly spaced beams covered by a floor of boards. The antique ceiling of stone beams is merely a translation of a wooden beam ceiling into stone. Pompeian paintings prove that the wooden beam ceilings of antiquity have their structural elements left visible. This was the only method of covering rooms in the middle ages, and such ceilings were richly colored and gilded for state apartjents. In the earlier Renaissance period, this was ornamentally treated in the new form of the style; but from the 18th century, it was supplanted by the various forms of panels.

Decorative treatment of such a ceiling (Fig.212) consists in making prominent the functions of the different parts. The beams support the roof and their lower surfaces are ornamented by stretched bands or interlaced work, to make apparent the horizontal enclosing of the room. A cyma placed at the top of the walls is a symbol of the support of the ceiling above it. The latter may be subdivided in small panels by enclosing bands, each decorated by a symbol of suspension in form of a star, a rosette, or similar ornament. Beams are laid on the wall and either rest on a continuous cornice, or on consoles. The first is suitable when the wall is lined with stone, this cornice then being also of stone as a part of the wall, and treated like an architrave. For other treatment of walls, especially with tapestries or paintings on its upper part, it is sufficient if supports of beams are wooden corbels or consoles. It is proper in large rooms to rest the beams supporting the ceiling on heavy girders or main beams (Fig.213). If these are placed at moderate distances, have supporting cornices along their sides, and the ceiling surface between small beams resting on them are panelled by enclosing bands, this produces a dignified and highly ornamental form of ceiling, which may be decorated by painted and sculptured ornament, producing a very rich effect. It

[illegible]

[illegible]
of the wall and to place main beams on heavy consoles. As for painting the
[illegible]
wood are seldom imitated, a combination of colors being generally employed
[illegible]
light, the surface of the ceiling having a dark tone, from which the colored or gilded ornament clearly detaches itself.

163. Visible Roof Trusses.

In buildings containing large rooms, the frame of the roof may be left visible, forming both ceiling and roof. But the construction of the trusses must [illegible] supporting the inclined ceiling, they may appear to the eye as sufficient. Decoration of these ceilings or roofs (Fig. 514) has the same requirements as horizontal beam ceilings. Rafters appear as large beams and rafters as light timbers supporting a covering of boards, that may be panelled by planking on beams. The structural parts should be painted light and ceiling surfaces dark. [illegible] ceilings were generally covered in this way, which was sometimes so rough [illegible] the same cost. The flat roofs of San Miniato at Florence and of the Cathedral at Monreale near Palermo are classical examples.

164. Ceiling with Coffers.

The coffered ceiling of wood with nearly square panels or coffers cannot be regarded as structural, but only as a decorative covering. Since beams are employed to enclose coffers in one direction, light boxes of boards are set in the other between the beams to complete the panelling. But the ensemble of coffers usually consists of light boxes of boards and is independent, being ornamented by bands and rosettes. Yet coffering produces an impression [illegible] rate of the dividing members as a strong framework, above which the coffers [illegible]

[illegible]

here appears necessary to suggest the subdivision of the ceiling in the frieze of the wall and to place main beams on heavy consoles. As for painting the structural wooden beam ceiling, in the best ancient examples the colors of wood are seldom imitated, a combination of colors being generally executed with purely decorative views; the beams and the bands enclosing panels being light, the surface of the ceiling having a dark tone, from which the colored or gilded ornament clearly detaches itself.

162. Visible Roof Trusses.

In buildings containing large rooms, the frame of the roof may be left visible, forming both ceiling and roof. But the construction of the trusses must then be very simple and of monumental dignity, so that as strong triangles supporting the inclined ceiling, they may appear to the eye as sufficient. Decoration of these ceilings or roofs (Fig. 214) has the same requirements as horizontal beam ceilings. Purlins appear as large beams and rafters as light timbers supporting a covering of boards, that may be paneled by planting on bands. The structural parts should be painted light and ceiling surfaces dark. The use of visible framed roofs is not certain in classic antiquity. Yet it harmonizes with the structural spirit of Grecian architecture, as Schinkel and Klenze have shown by architectural designs. In the early middle ages, basilicas were generally covered in this way, which was sometimes so richly treated, that a splendid horizontal ceiling might have been constructed at the same cost. The framed roofs of San Miniato at Florence and of Cathedral at Monreale near Palermo are classical examples.

163. Ceiling with Coffers.

The coffered ceiling of wood with nearly square panels or coffers cannot be regarded as structural, but only as a decorative covering. Since beams are employed to enclose coffers in one direction, light boxes of boards are set in the other between the beams, to complete the paneling. But the entire system of coffers usually consists of light boxes of boards and is suspended, being ornamented by bands and rosettes. Yet coffering produces an impression of an ideal construction. The intersecting beams are represented by the soffits of the dividing members as a strong framework, above which the coffers are two or three recesses above each other (Fig. 215). The upper recesses are reductions of the lower form, and with their diminished size, the enclosing mouldings are also reduced. At the center of the coffer is a suspended ornament or a large conventionalized flower or rosette. For larger surfaces, scroll ornaments may spring from the rosette and spread over the ground of the coffer.

The coffer appears most richly treated, when dentils and consoles are substituted for simple enclosing angular recesses. Coffered ceilings of the great

[illegible] the bead, [illegible] parts [illegible] all the [illegible] of the Corinthian order are represented in the [illegible] employing the recom- [illegible] surmounting [illegible]. Transition to the wall is effected by a corn- ice, usually consisting of an ogee with cymas above and beneath; the angle [illegible] the [illegible] extends along below the cornice.

The [illegible] form of such a ceiling most clearly appears when but few [illegible] over thereon. White and gold are appropriate for [illegible] the [illegible] or [illegible] of the rosettes and of the [illegible]. [illegible] and stronger coloring of walls, the ceiling produces the most [illegible] when all the ornament and framework is in gold, the ground of the [illegible] and the [illegible] being [illegible]. If the wall has a frieze below [illegible] with large [illegible], the divisions of the ceiling should be short [illegible], decorated by figures in relief, candelabra, or suspended wreath [illegible].

[illegible] a [illegible] panel may be [illegible] the [illegible] [illegible] panels [illegible] placed in the centres of the sides and at the angles. The same [illegible] forms the basis of such a coffered ceiling. A series of strong beams are [illegible] and [illegible] and forms the structure [illegible] between which recessed surfaces appear as panels decorating by ornaments [illegible]. [illegible] great [illegible] in the panelling is not permissible, because the construction [illegible].

[illegible] Beamed Ceilings.

[illegible] are different for ceilings, where the surface of the covering above a series of beams is subdivided by slightly projecting strips. Each division does not [illegible] the construction, but appears as a light [illegible] that the centre should be made prominent by a larger panel with a rosette, figure or similar motive. While a ceiling with deep coffers is appropriate for [illegible] and large rooms, beamed ceilings would be suitable for small rooms of less height. The natural color of the wood then usually forms the ground tone of the decoration, which may consist of flat ornament with a partial [illegible] moulded cornice. Such ceilings harmonize well with wainscoted walls. The wainscoting may then extend to the ceiling and connect with it by the corn- ice.

[illegible] Painted Ceilings.

basilicas erected during the Renaissance period frequently have all the details of the Corinthian entablature represented in the beams enclosing the recesses. Five to seven coffers generally compose the width of the ceiling; a greater number appears monotonous. Transition to the wall is effected by a cornice, usually consisting of an angle with cymas above and beneath; the angle is frequently replaced by a row of dentils. The complete width of the soffit between the coffers likewise extends along beside this cornice.

The rich sculptured form of such a ceiling most clearly appears when but few colors are employed thereon. White and gold a re appropriate for enclosing parts, with blue or red for background of the rosettes and of the soffits. With deeper and stronger coloring of walls, the ceiling produces the most magnificent effect, when all the ornament and framework is in gold, the ground of the coffers and the soffits being blue. If the wall has a frieze below a ceiling with large coffers, the divisions of the ceiling should be short flat pilasters, decorated by figures in relief, candelabra, or suspended wreaths of fruits (Fig. 216).

Instead of extending a uniform series of coffers over the entire ceiling, a larger panel may be arranged at its center, suitable for recieving an important picture; smaller panels enclose the central space (Fig. 217) with special shapes located at the centres of the sides and at the angles. The same principle always forms the basis of such a coffered ceiling; a series of strong beams are characterized as under stress and forms the structural framework. between which recessed surfaces appear as panels decorating by ornaments or figures. Too great fancifulness in the paneling is not permissible, because the construction is thereby made impossible.

164. Banded Ceilings.

Requirements are different for ceilings, where the surface of the covering above a series of beams is subdivided by slightly projecting strips. Such a division does not concern the construction, but appears as a light network stretched over the ceiling. To such decoration applies only the law (Fig. 218) that the centre should be made prominent by a larger panel with a roseete, figure or similar motive. While a ceiling with deep coffers is appropriate for high and large rooms, banded ceilings would be suitable for small rooms of less height, The natural colr of the wood then usually forms the ground tone of the decoration, which may consist of flat ornament with a partial painting and gilding of the wood. Transition to the wall is formed by a delicately profiled cornice. Such ceilings harmonize well with wainscoted walls. The wainscoting may then extend to the ceiling and connect with it by the cornice.

165. Painted Ceilings.

[illegible]

[illegible] of [illegible]. The painting of the ceiling should cause the upper [illegible] to appear like a [illegible] canvas. Therefore this surface [illegible] a broad [illegible] band and an ornamental center, which represent [illegible] [illegible] and enclose the surface and is painted as flat ornaments, [illegible]

[illegible] must have cast shadows on the surfaces. Only sparingly [illegible] with picturesque [illegible]. Since these represent [illegible] parts of the surface special decorations (Fig. [illegible]).

[illegible] decorations are [illegible] executed in [illegible] of lime or [illegible]. It is easy to combine painting with low relief, the [illegible] of the [illegible] may have [illegible] raised forms, like [illegible], and be distinctly raised from the background by color [illegible]. The [illegible] gray shading produced on such relief [illegible] makes a pleasing contrast to the [illegible] colors of the [illegible].

[illegible] such ceilings, the center is always [illegible] by a larger panel, surrounded by smaller panels at the sides and [illegible]. [illegible] The form of surface of ceiling naturally determines arrangement and [illegible] of the panels, and a generally applicable rule can scarcely [illegible]. The [illegible] arrangement is always the square (Fig. [illegible]). Ornaments [illegible] and should always extend from the outer border inward, as if the ceiling [illegible] when [illegible] viewed from below. Transition to the wall may be by a [illegible] profiled cornice; yet a larger cavetto is appropriate, since this corresponds to the [illegible] of the stretched canvas and appears [illegible]. Beneath such a form of ceiling the wall frieze is most frequently [illegible] by [illegible] and [illegible] large paintings in the architectural [illegible]. The [illegible] treated [illegible] a frieze [illegible] a place for plastic representations of figures and for decorations.

[illegible]. Architraves [illegible].

[illegible] the building should be lighter and [illegible] than those on its exterior. The pediment caps have smaller dimensions, since they are chiefly viewed obliquely from below. The [illegible]

[illegible]

Forms of ceilings previously treated contrast with those consisting of decorations of stucco-work. The painting of the ceiling should cause the upper surface of the room to appear like a stretched canvass. Therefore this surface recieves a broad bordering band and an ornamental center, which represents free suspension and approximates to the ornamental forms of textile art. Bands that divide and enclose the surface may be painted as flat ornaments, or be raised in low relief. Painted ornament in the spaces may itself be slightly shaded, but must have cast shadows on the surfaces. Only separately enclosed pictures may be treated with picturesque freedom, since these represent on the principal parts of the surface special decorations (Fig. 219).

Such ceiling decorations are usually executed on a plastering of lime or plaster of Paris. It is easy to combine painting with low relief; the bordering forms of the dividing bands may have sharply raised forms, like cymas and beaded astragals, and be distinctly raised from the background by colored bands adjacent to it. The delicate gray shading produced on such relief mouldings by side lights makes a pleasing contrast to the full colors of the bands of ornament.

As for division of the surfacesof such ceilings, the center is always made prominent by a larger panel, surrounded by smaller panels at its sides and angles. Between them connecting bands of ornament subdivide the surfaces so far as necessary. The form of surface of ceiling naturally determines arrangement and shape of the panels, and a generally applicable rule can scarcely be given. The easiest arrangement is always the square (Fig. 220). Ornaments in intermediate spaces may be plant forms, candelabra, small figures, garlands, etc., and should always extend from the outer border inward, as if the ceiling rises at the center and the ornaments grow upwards; this arrangement is also conveniently viewed from below. Transition to the wall may be by a delicately profiled cornice; yet a larger cavetto is appropriate, since this form corresponds to the lightness of the stretched canvass and apparently excludes ll loading. Beneath such a form of ceiling, the wall frieze is most readily decorated by arabesques and by inserting large paintings in the architectural order beneath them. The Italian Renaissance treated such a frieze decoration richly and elegantly, for the free upper wall surface is the most visible place for pleasing representations of figures and for decorations.

186. Architraves of Doors.

Architraves of doors within the building should be lighter and of more elegant form, than those on its exterior. The pediment caps have smaller dimensions, since they are chiefly viewed obliquely from below. The Renaissance almost always constructed the door jambs and soffits of stone, and in the earlier period gave to them a wide decorated band (Doorways in Palace of

Urbino). Large doorways are finished with pilasters or columns supporting an entablature. A free decorative treatment of supporting forms is suitable here. Pilasters may change into hermes figures and columns may be decorated by rings, rows of leaves, or incisions, in the most varied ways. A crowning ornament is also placed as a decoration over the pediment cap. An angular or curved pediment may either be broken at the center to recieve a bust or vase, or above the horizontal cornice of the cap may be placed special ornaments at ends and centre, connected by ornamented volutes or scrolls. Doors are usually of wood, only being of bronze in rare state doorways, and they are composed of framework and panels. The paneling depends upon the style and character of the adjacent architecture. Uniform square panels with rosettes on the panels and with disks or knobs on intersections of frame are appropriate for monumental doors; division into small and large panels of different forms decorated by ornaments or figures produces an elegant impression, and harmonizes with varied ornamentation of the room.

167. Large Rooms.

Large rooms require a clearly arranged architecture, which divides the wall and appears as a structural framework for its decorative covering. This purpose is most simply fulfilled by a series of pilasters forming two orders, if the room extends through two stories. The upper order is kept low and no frieze is assigned to its entablature. The arrangement of the pilasters produces a rythmical division of the intervals, adapted to any particular form of the apartment. Effective contrast in decoration of the intervals are obtained by covering the lower ones by ornamental forms or tapestries, the upper ones having figures. The ceiling must in its division accord with the arrangement of the pilasters; supporting beams must correspond to the separate supports.

168. Basilican Designs.

The special purpose and especially the necessary width may require the room to take the form of a basilica. This essentially consists of a high central space or aisle with colonnades or arcades along each side opening into lower rooms or side aisles, and lighted by windows in its sides above these. Side aisles may recieve light from the middle aisle, or external windows may be in the side walls. The light falls in the middle aisle from above and is very satisfactory for the general effect and for the decorations. Division into longitudinal aisles makes possible a great width with proportionally small spans to be covered, and with its varied heights and the arrangement of its columns, it produces a rich prespective effect. In decorating the interior, it is necessary to make the upper portion of the center aisle as light as possible, so as to not produce a heavy effect above the rows of

columns. The greater scale of side aisles requires a rather high wall above the spandrels of the arches, and this may be decorated in the way of a deep sculptured frieze. The upper walls above this have light pilasters, supporting the high, [illegible] cornice, with arched windows in the intervals [illegible] and [illegible], surfaces are decorated by [illegible] patterns. In contrast to the rich decoration of the upper portion, the side aisles may be treated [illegible]. To [illegible] the lower story appears as if actually [illegible] [illegible]. [illegible] of side aisles may have a [illegible] [illegible] with [illegible] [illegible] to [illegible] walls together.

[illegible] Side aisles with Galleries.

[illegible] with galleries the colonnades [illegible] above and below, [illegible] the lower order is then [illegible] : [illegible] [illegible] [illegible] [illegible] [illegible] the spacing of the columns. [illegible] is to be [illegible] of [illegible]. [illegible] [illegible] may be set over the [illegible] and produce a [illegible]. [illegible] [illegible] than [illegible] of the [illegible]. [illegible] may have a [illegible], if a third story with [illegible] [illegible] [illegible] a [illegible] support for the upper walls. The [illegible] [illegible] [illegible] [illegible] a [illegible] [illegible] the [illegible] of the [illegible], the [illegible] being [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] two [illegible] [illegible] [illegible] [illegible] [illegible] of the [illegible]. [illegible] combination of the gallery with coupled columns [illegible] a particularly satisfactory effect, and the gallery will take the character of a [illegible] enclosure; but this arrangement [illegible] a [illegible] general effect in the room, and [illegible] [illegible] construction.

[illegible] of [illegible] plan.

With rooms having galleries [illegible] [illegible] assembly halls, which [illegible] [illegible] [illegible] [illegible] a gallery open to the interior through [illegible] or arcades. A large [illegible] or [illegible] is usually arranged [illegible] [illegible] wall [illegible] the [illegible] or platform. Such rooms afford surfaces very appropriate for [illegible] decorative treatment. [illegible] [illegible] rows of [illegible] [illegible] [illegible] may be arranged on the continuous wall. The [illegible] [illegible] of the [illegible] [illegible] for a larger figure of [illegible] [illegible]. [illegible] [illegible] [illegible] surfaces for varied decoration and [illegible] [illegible]. The [illegible] may be [illegible] to represent a [illegible] and richly [illegible] [illegible].

[illegible] Rooms with Vaulted Ceilings.

[illegible] [illegible].

For the construction of plane ceilings and for [illegible] [illegible], [illegible] [illegible]

columns. The adjacent roofs of side aisles require a rather high wall above the spandrels of the arches, and this may be decorated inside by a deep sculptured frieze. The upper walls above this have light pilasters, supporting the high suspended ceiling with coffers; windows in the intervals have graceful architraves, surfaces are decorated by tapestry patterns. In contrast to this light decoration of the upper portion, the side aisles may be veneered with marble or stucco, so that the lower story appears as if entirely executed in stone. Ceilings of side aisles may have a massive character with large beams, serving to tie the walls together.

169. Rooms with Galleries.

These (Fig. 221) usually have two colonnades or arcades above each other. Ratio of height of lower to upper odrer is then taken 3 : 2 or 4 : 3. Practical uses of such an apartment usually require wide spacing of the columns. The straight entablature is to be madeas if constructed of wood. Cap blocks with consoles at each side may be set over the capitals and produce a good effect, materially reducing free span of the architrave beam. Rooms with galleries may also have a basilican plan, if a third story with pilasters be provided; yet this produces a rather weak support for the upper walls. The following arrangement has a monumental effect: colossal columns directly support the walls of the clear story, its windows being placed between low pilasters and are wider than high: behind the columns and at less than two-thirds their height, galleries are supported by inserted pilasters or corbels. This combination of the gallery with colossal columns will not have a perfectly satisfactory effect, and the gallery will take the character of a wooden enclosure; yet this arrangement produces a dignified general effect in the room, and is stron construction.

170. Halls of Semicircular Plan.

With rooms having galleries belong semicircular assembly halls, which contain above a closed corridor a gallery open to the interior through colonnades or arcades. A large recess or niche is usually arranged in the straight wall for the tribune or platform. Such rooms afford surfaces very appropriate for beautiful decorative treatment. Above concentric rows of seats, a frieze with figures may be arranged on the continuous wall. The semicircular arch of the niche is suitable for a larger figure of especial importance. Beside the niche are surfaces for varied decoration and sculptured ornment. The ceiling may be painted to represent a stretched and richly ornamented canvass.

b. Rooms with Vaulted Ceilings.

171. General.

For the construction of plane ceilings and for covering them, the most

[illegible] are used and require a corresponding variety in [illegible] treat-
ment. But in vaulted rooms all surfaces of the ceiling are considered of
the same bearing material. The ornamental treatment may then be a con-
tinuation of the constructive forms of the different parts. Tapestry dec-
oration, [illegible], etc., always appear as additions [illegible] in
vaulted rooms, the proper structural and decorative potential is simple and sim-
ilar [illegible] architectural [illegible] forms [illegible]
possible, [illegible] various treatment of [illegible]
and [illegible] abundance of ornamental forms.

The general [illegible] first given in the form of
vault and [illegible] construction of the wall. Which is [illegible]
[illegible], but [illegible] forms [illegible]
[illegible] and the [illegible] never [illegible]
[illegible], but always [illegible] with the treatment of the [illegible]
[illegible] and at [illegible] the condition of the [illegible]
of the [illegible] of the masses. The [illegible] ornamental [illegible]
[illegible] the supporting masses [illegible]
[illegible], which is always combined in monumental architecture
the [illegible] of great weight [illegible]
[illegible] between support and load, [illegible] and lightness of [illegible]
[illegible] remains is to be forgotten.

Vaults [illegible], considered as homogeneous stiff shells, [illegible]
surface [illegible] to be uniform, like that of a ceiling curved in different
forms. Like the plane ceiling, it is composed of stiff [illegible]
[illegible] structural framework, with spaces or panels between them, [illegible]
may be considered as [illegible]. The [illegible] will consist of ribs, [illegible]
and of [illegible] between them, expressing separation and [illegible], and
the enclosure of space.

[illegible]. [illegible] vaults.

The vaulted [illegible] and its thrust on the side walls, [illegible]
[illegible], [illegible]. The side walls require [illegible]
[illegible]
They fulfil that purpose just as well if divided into isolated [illegible] piers, [illegible]
[illegible] the springing lines are again connected by arches. Spaces between
the [illegible] form extensions of the principal room into niches or [illegible]
[illegible] ends may be freely opened into [illegible] or colonnades, or [illegible]
[illegible] doorways and windows. [illegible] vaults are [illegible]
[illegible]
[illegible] stone with [illegible] spaces between them. [illegible]
[illegible]

varied materials are used and require corresponding variety in decorative treatment. But in vaulted rooms, all surfaces of the ceiling are constructed of the same building materials. The ornamental treatment may then show a certain harmony in the conventional forms of the different parts. Tapestry coverings, wooden wainscoting, etc., always appear as extraneous additions in vaulted rooms; the proper structural and decorative material is stone and similar materials. But since these materials are treated in varied forms, are painted, or may be used as veneering, this varied treatment of similar materials produces an abundance of ornamental forms.

The general arrangement of the decoration is first fixed by the form of vault and by the construction of the wall. Vaults do not act merely as vertical loads, but are covering forms with thrusts, requiring abutments or buttresses. But the Antique and the Renaissance never left this construction externally exposed, but always connected it with the treatment of the room. This appears necessary and it makes the solution of the statical problem visible in the subdivision of the masses. The architectural and ornamental treatment then undertakes to clothe with an ideal construction the supporting masses and those covering the room, with which is always combined in monumental architecture the expression of great weight, this ideal construction indicating only contrast between support and load, and by its grace and lightness of forms causing the weight concealed behind it to be forgotten.

Vaults are decoratively considered as homogeneous stiff shells. Their decoration is then to be uniform, like that of a ceiling curved in different forms. Like the plane ceiling, it is composed of stiff arches or ribs, forming a structural framework, with spaces or panels lying between them, which may be considered as openings. The enclosing wall consists of supporting piers and of screen walls set between them, expressing aspiration and support, and the enclosure of space.

178. Tunnel Vaults.

The tunnel vault lays its load and its thrust on the side walls, while the end walls merely enclose the room The side walls require for the thrust a a much greater thickness, than would be necessary to support the thrust alone. They fulfil their purpose just as well if divided into isolated deep piers, which below the springing lines are again connected by arches. Spaces between the piers form extensions of the principal room like niches or chapels. The walls at the ends may be freely divided into piers or colonnades, or be filled with large doorways and windows. Tunnel vaults are either built of uniform thickness, as in brickwork, or composed of separate supporting transverse arches of cut stone with slabs or light masonry placed between them. In the first, side walls may be divided into piers and niches at pleasure, but in the last,

supporting piers must be set under the arches of the vault (Fig. 222).

The forms of construction described suggest the mode of decorating surfaces of vaults. The tunnel vault has a uniform decoration over its entire surface, appearing in many variations, from painted network or foliage-like decoration to a series of deep coffers. Elegant painted vaults are found in the baths at Pompeii (repeatedly interwoven bands enclose panels of different dimensions, in which soar small figures), in Roman tombs (usually combined with fine stucco work), and Renaissance villas (Villa of Pope Julius, arched corridor with delicate lattices and scrolls of foliage). Coffers (Fig. 223) are treated on the same primary principle as plane ceilings, and may have square or polygonal coffers alternating with small square ones. In Roman architecture, only arches and horizontal beams were of brickwork, wooden forms being set on the centering to form the coffers, this portion of the vault being of concrete. (Temple of Venus and Roma; Basilica of Constantine; Rome). A row of coffers is always found at the crown of the vault, usually with a larger panel at the center (The ornamental arrangement of such panels in vaults of triumphal arches permits the assumption of ceiling lights in vaults of temples). The number of coffers in the width is 7 to 15, according to dimensions of the vault.

A strongly projecting cornice separates the wall and vault. Its forms are derived from those of the Ionic or Corinthian entablature. Its projection conceals from below a large part of the surface above it. This indicates that decoration of the vault must commence above a plain band of the same depth as the cornice, and that the vault should be stilted accordingly. Subdivision of walls below the springing may be according to different systems:- 1. In solid walls, separate niches may be arranged with pediments and columns, a continuous frieze extending above them. 2. If the wall be interrupted by large niches covered by tunnel vaults or half domes, free columns may be set before the piers, their entablature at the same time forming the cornice for the vaults over the niches. Above the columns are suitable places for statues. Lighting is best effected by large semicircular windows in walls at ends of vaults.

Different antique structures exhibit a structural and decorative development of tunnel vault in cut stone, that recalls stone beam ceilings of temples. Stron supporting ttansverse arches have sections like beams bent into a semicircle; on these are set closely large moulded stone slabs. Such a construction produces a monumental impression in accordance with the material, yet the arches project strongly, and when viewed obliquely, conceal a large part of the slabs and appear monotonous by reptition. The Renaissance treated tunnel vaults generally in accordance with these principles, but proceeded in a

purely decorative way (Figs. 224, 225). Transverse arches are flat, are decorated by bands on their lower surfaces and by cymas on their sides; the slabs have large panels low mouldings, and consist of framework and panels according to the structural princi.le. The entire ornamentation represents ideally a light curved flat ceiling, or perhaps a bronze decoration of the vault. This decoration of vaults is intimately connected with the architecture of the longitudinal walls, subdivided into separate parts. Pilasters are set under the arches and are even in pairs, to support a wide paneled arch. The light character of the intermediate vaulting introduces intersecting vaults with windows over the arched openings or chapels along the sides. Such architecture affords good lighting for the rooms and produces great freedom and variety in decorative treatment. Large vaulted Renaissance churches afford exeellent examples. The strong buttresses of tunnel vaults permit the formation of side rooms or chapels, again covered by tunnel vaults at right angles to the principal one, by groined, or by welsh-groined vaults.

In small rooms lighted at their ends, tunnel vaults may be set on colonnades or arcades, the thrust being transmitted through the ceiling of the side passage to the outer wall. With light and graceful decoration of the vaults, such rooms produce a rich and elegant impression (Fig. 226). We might give to tunnel vaults over large flat rooms a flat elliptical form. A varied panelling with flat enclosing borders should be most suitable as decoration, to produce an impression of great lightness in ornamental treatment, like the construction. Such an example is supplied in the magnificent ceiling of the Library of St. Mark in Venice, Fig. 227, decorated by paintings by Paul Veronese.

The inclined tunnel vault is used over stairways. Decorative transverse arches are not placed at right angles to the axis, but must always be set vertically. Since oblique intersections with longitudinal bands result, scrolls of leaves and fruits are most appropriate for ornamenting the entire visible framework, giving the vault a very light effect, making imperfections in subdivision not prominent. A magnificent example is found in the Scala d'oro in the Doge's Palace at Venice (Figs. 228, 229). The festoons are white on gold groundand the enclosing cymas, etc., are partly white with gold framework. Large spaces on each side contain colored figures, those in the middle have white reliefs on gold ground; long bands have colored ornaments on light ground, and small squares arr filled with reliefs on gold ground. On account of the ratio of length to the small width of the stairway, the irregular treatment of the wall surfaces is not easily perceived, since one views the whole as foreshortened.

173. Groin Vaults.

While the entire length of the tunnel vault rests on abutments, the groined vault is the [illegible] of the tunnel vaults, only resting at four points on supporting piers. Its pressure first loads the four groins or ribs extending diagonally between the abutments, and it is transmitted by these groin arches to the piers. The decoration is closely connected with these groins which are considered as principal lines; the vaulted compartments are regarded as uniform surfaces between the groins. The groins or ribs are first ornamented by [illegible] scrolls or similar forms in relief, along every single [illegible] or leaded [illegible] in the middle of the vault may be placed a rosette (Fig. 390), or a figure in a circular or polygonal frame. Decoration of [illegible] simple forms, if at the centre of each triangle be placed a circular or [illegible] panel containing a figure. The direction of the object is from the vault towards the centre; the angles are filled by ornament extending from the springings. In contrast to the decoration of the arches, the [illegible] ornamentation of these surfaces may be either by painting or in low relief, [illegible] light [illegible] or ornamental [illegible] stretched between [illegible].

[illegible]

[illegible] must be massive piers, capable of resisting both vertical pressure and the thrust. [illegible] than, projecting pilasters [illegible] transverse arches and ribs of the vault, permitting [illegible] between the springing of the vault and before the pilasters, [illegible] to support the vault, then according to the light & decoration of the vault, the supporting forms will have a character of light [illegible] the vault with the graceful forms appearing to lightly rest on the [illegible]. This arrangement was especially peculiar to large antique domes with groined vaults (Fig. 397). Spaces between the piers are joined to the central room and large semicircular niches may be placed in the wall [illegible] them and through the [illegible] (Fig. 397). These spaces are frequently separated from the central room by [illegible].

[illegible] was subdivided, and produced a character of [illegible]

While the entire length of the tunnel vault rests on abutments, the groined vault is the intersection of two tunnel vaults, only resting at four points on supporting piers. Its pressure first loads the four groins or ribs extending diagonally between the abutments, and it is transmitted by these groin arches to the piers. The decoration is closely connected with these f groins, which are considered as principal lines; the vaulted compartments are regarded as uniform surfaces between the groins. The groins or ribs are first ornamented by foliage scrolls or similar forms in relief, along their sides extending cymas or beaded astragals as a transition to the surfaces of the vault. In the middle of the vault may be placed a rosette (Fig. 230), or a figure in a circular or polygonal frame. Decoration of intermediate surfaces produces simple forms, if at the centre of each triangle be placed a circular or pentagonal panel containing a figure. The direction of the object is from the outside towards the center; the angles are filled by ornament extending from the springings. In contrast to the decoration of the arches, the entire ornamentation of these surfaces may be either by painting or be in low relief, appearing as light tapestries or ornamental network stretched between foliage scrolls.

In a series of groin vaults the bays are usually separated by flat panelled transverse arches. Yet the compartments of the vault may be joined and decorated together. Large square panels may then be surrounded by smaller polygons and produce a good effect, for they appear in continuous straight lines as viewed lengthwise the vault.

Abutments must be massive piers, capable of resisting both vertical pressure and the thrust. Inside them, projecting pilasters with entablatures recieve transverse arches and ribs of the vault, permitting the observer to forget the thrust that acts sidewise. If free columns with an entablature are set beneath the springing of the vault and before the pilasters, merely appearing to support the vault, then according to the light s decoration of the vault, the supporting forms will have a character of light aspiration and support, the vault with its graceful forms appearing to lightly rest on the columns. This treatment was especially peculiar to large antique columns with groined vaults (Fig. 231). Spaces between the piers are joined to the principal room and large semicircular windows may be placed in the wall above them and beneath the arch, through which room is lighted in the most satisfactory way. These spaces are frequently separated from the central room by small colonnades.

The groin vault is especially suitable for arcadrs open along one side. In Roman Renaissance architecture, piers recieved on their external sides engaged columns with an entablature above them. Thus the heavy form of the pier was subdivided, and recieved a character of aspiration and support; the engag-

ed columns further to serve to strengthen the abutments, for the piers require considerable depth to resist the thrust, with but moderate width. The [illegible] [illegible] [illegible] [illegible] results, [illegible] [illegible] [illegible] [illegible] ers or columns instead of piers; yet the imposts must be tied by iron rods.

[illegible] 274. Pendentive Vaults.

Pendentive vaults are closely allied to groin vaults by their uses, and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] ed abutments. Semicircles on the four sides limit the surface of the vault; a horizontal circle at the crowns of these arches divides it into a central spherical calotte and four pendentives. These surfaces are much better suited to a rich system of decoration, than are those of the groin vault of four compartments, and the former is therefore preferred to the latter in modern architecture. In general operation, the pendentive vault is similar to the groin vault, but the side arches receive part of the thrust, and should therefore not be too narrow in such vaulted portions. These arches have plain [illegible] at their soffits, and their slightly projecting faces are bordered by [illegible] The calotte is only separated from the pendentives (Fig. [illegible]) [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. Suitable modes of decorating the calotte by coffers, by division into four large [illegible] panels with figures, between these being narrow bands with a decorated circular space at the crown (Fig. 232), or [illegible] representing a tent roof with its decorations. Pendentives contain [illegible] [illegible], garlands, medallions, or ornaments rising from the imposts. [illegible] [illegible] are light in color, general tone; decorative panels being colored.

[illegible] [illegible] prefer the groin vault for covering large rooms, it may be assumed it was better adapted to construction in concrete with separate groins. [illegible] would be a vault with spherical surfaces. For vaults of [illegible] of stonework, the pendentive vault presents less difficulty and has greater strength at crown than the groined vault, which is very flat there. Subdivision of rectangular rooms into separate squares and covering these by pendentive vaults produces a plan of room similar to that of Roman halls with groin vaults (Figs. 194, [illegible], [illegible].) Vaults may likewise be apparently supported by columns set before the piers, whose entablature forms the impost. Lighting may be either by large windows at sides and in walls beneath the arches, or by openings in vaults. Spaces or arches between the piers are covered by tunnel vaults, and are suited to receive galleries above small colonnades, which naturally heighten the effect of the colossal columns supporting the vaults and of their [illegible] [illegible]. This produces [illegible] [illegible] [illegible] [illegible] fective gradation of architectural forms and of enclosing surfaces, very ap-

ed columns further to serve to strengthen the abutments, for the piers require considerable depth to resist the thrust, with but moderate width. The greatest lightness of construction results, if in vaulted porticoes groined vaults rest on columns instead of piers; yet the imposts must be tied by iron rods.

174. Pendentive Vaults.

Pendentive vaults are closely allied to groin vaults by their uses, and consist of a spherical surface described with half diagonal of square to be vaulted as radius. Semicircles on the four sides limit the surface of the vault; a horizontal circle at the crowns of these arches divides it into a central plain calotte and four pendentives. These surfaces are much better suited to a uniform system of decoration, than are those of the groin vault of four compartments, and the former is therefore preferred to the latter in modern architecture. In statical condition, the pendentive vault is similar to the groin vault, but the side arches recieve part of the thrust, and should therefore not be too narrow in open vaulted porticoes. These arches have plain panels in their soffits, and their slightly projecting sides are bordered by cymas. The calotte is only separated from the pendentives (Fig. 232) by a belt of slight projection, since at this band the surface of the vault is inclined at 45 degrees. Suitable modes of decorating the calotte by coffers, by division into four large panels with figures, between them being narrow bands with a decorated circular space at the crown (Fig. 233), or by representing a tent roof with its decorations. Pendentives contain soaring figures, garlands, medallions, or onnaments rising from the imposts. All belts and enclosures are light in their general tone, decorative panels being colored.

If the Romans preferred the groin vault for covering large rooms, it may be because it was better adopted to construction in concrete with separate cross arches, than would be a vault with spherical surfaces. For vaults entirely of brickwork, the pendentive vault presents less difficulty and has greater strength at crown than the groined vault, which is very flat there. Subdivision of rectangular rooms into separate squares and covering these by pendentive vaults produces a plan of room similar to that of Roman halls with groin vaults (Figs. 234, 234a, 234b) Vaults may likewise be apparently supported by columns set before the piers, whose entablature forms the pier cap. Lighting may be either by large windows at sides and in walls beneath the arches, or by skylights in vaults. Spaces or chapels between the piers are covered by tunnel vaults, and are suited to recieve galleries above small colonnades, which materially heighten the effect of the colossal columns supporting the vaults and of their massive entablature. This produces great variety and effective gradation of architectural forms and of enclosing surfaces, very ap-

The character of the dome rests on a vertical cylindrical wall, exerting on this a uniform pressure and thrust; this cylindrical wall requires a treatment like that of walls supporting a tunnel vault. The wall can be pierced by openings, or it may be concentrated in supporting piers connected by arches below the springing. The deep niches or chapels of the Pantheon [illegible] eight great piers, which [illegible] contain [illegible] semi-circular spaces. The vertical cylindrical wall is separated from the dome by a bold entablature, which should usually correspond to that of a colonnade of equal height. As decorations for the [illegible] of [illegible] square coffers are appropriate, since the vertical and horizontal ribs [illegible] the form of the [illegible]. [illegible] is [illegible] to [illegible] height. Around the opening, a deep [illegible] surrounds the skylight, [illegible] by a [illegible] moulding with the [illegible]. The opening for light has a diameter of [illegible], and its vertical surface is dressed as a [illegible]. Its [illegible] have a round [illegible] ornamented by leaves.

The division into coffers is independent of subdivision of wall beneath; and the dome may instead be decorated by large panels alternating with [illegible] small [illegible]. Large round spaces are usually surrounded by [illegible] narrow panels or [illegible], being enclosed above and below, and small square coffers are then placed at the angles. [illegible] In the treatment of the [illegible] vault, the [illegible] and the [illegible] may [illegible]. The large panels may then be enriched by delicate mouldings, [illegible] figures [illegible] in painting [illegible] the dome covered [illegible] and [illegible]. [illegible] effective [illegible] be arranged in the wall above the great lower [illegible]. The [illegible] of wall, the [illegible] lighting [illegible] light from above, illuminates all objects in an unusual and very effective manner, and imparts to a domed interior a solemn and [illegible] effect [illegible].

[illegible] Vaults [illegible].

All forms of vaults [illegible] are based on the [illegible] in [illegible] and [illegible], [illegible] of [illegible] are [illegible] by [illegible] forms of vaults. [illegible]

propriate for decorative treatment. Yet with all its richness, a clear arch-structural subdivision predominates, and this mode of treating an interior produces an imposing and rich, and harmonious impression.

175. Domes.

The perimeter of the dome rests on a vertical cylindrical wall, exerting on this a uniform pressure and thrust; this cylindrical wall requires a treatment like that of walls supporting a tunnel vault. The wall may be penetrated by openings, or it may be concentrated in supporting piers connected by arches below the springing. The deep niches or chapels of the Pantheon in Rome (Fig. 235), apparently divide the wall into eight great piers, which externally contain hollow semicircular spaces. The vertical cylindrical wall is separated from the dome by a bold entablature, which should nearly correspond to that of a colonnade of equal height. As decorations for the dome, coffers of approximately square shape are appropriate, since the vertical and horizontal ribs clearly emphasize the form of the hemisphere. In the best examples, the number of coffers in one row is 24 to 28, with 5 or 6 in height. Above the coffers, a deep ring surrounds the sky-light, bordered by a delicate moulding next the latter. The opening for light has a delicate cornice at top, and its vertical surface is treated as a frieze-like band. Its lower edge may have a round moulding ornamented by leaves.

The division into coffers is independent of subdivision of wall beneath. But the vault may instead be decorated by large panels alternating with narrowbands or small coffers. Eight broad spaces are usually separated by intervening narrow panels or bands, being enclosed by these above and below, and small square coffers are then placed at the angles. As in the treatment of the tunnel vault, the relief is kept low and the bands or ribs project only so far that cymas may be formed beside them. The large panels may then be enclosed by delicate mouldings, receiving figures in low relief or paintings. This treatment appears especially appropriate, when the dome covers a plygon and not a circle. Such antique interiors show effective treatment of the wall; a gallery is arranged in the wall above the great lower niches and opens into the room by an arch above each niche, supported by small columns. The circular closed form of wall, the vaulting recalling the sky, the light from above, illuminating all objects in an unusual and very effective manner, all impart to a domed interior a solemn and earnest effect, making it especially suited for sculptures in relief.

176. Groin Vaults enclosing Panels.

All forms of vaults heretofore considered are based on the semicircle. But in residences and palaces, heights of larger apartments are seldom sufficient to be covered by previous forms of vaults. These are rather used on a large

scale in monumental public buildings, churches, museums, libraries, etc. Where used in residences, this is on a small scale in vestibules, loggias, corridors, etc. But to give ceilings in palaces a monumental decoration and make them suitable to recieve costly ornamentation and paintings, the Renaissance invented vaults, which required less rise for large spaces, thereby approximating to plane ceilings. These consist of various forms of groin or coved vault with horizontal central panel (Figs. 236, 237). This form of vault rises steeply from the wall and towards the centre passes into a larger slightly curved or plane surface. Such vaults are seldom built with reference to the forces acting in them and their durability chiefly depends on good mortar. A true vault of this kind over a rectangular room has the central surface supported by half tunnel vaults (cove ceiling, Fig. 238). Reducing the central surface, this form passes into the cloister vault. The best proportions for decorative treatment result, when the central space with its enclosing cornices has about half the dimensions of the rectangle enclosed by springing lines. The half tunnel vault is then suitable to recieve large pictures, extending from lower to upper border, conveniently placed for the eye. These painted surfaces may be limited at angles by extending the bands enclosing the central space. These triangles may be filled with arabesques, perhaps with a middle panel. The central space is enclosed by a delicate cornice of slight projection with a broad band. To not require masses of stucco-work, the section of this band should be kept close to surface of the vault. The subject of this central panel should contrast with the lower figures, and be decorative in its nature, consisting of rosettes, arabesques, garlands, shields of arms, etc. Beautiful examples of such Renaissance decorations are found in the middle loggia corridor in the Vatican containing Raphael's Biblical pictures, (where this vault is used above semicircular arches to cover the separate bays of a long corridor), as well as in the salons in Massimi Palace and in Villa Lanti at Rome.

The most extended use during the Renaissance was made of that form of this vault with the cove intersected by a series of compartments, thus forming a half groined vault (Figs. 239, 240). The middle surface consists of panels of two kinds, alternating in shape and location and very suitable for decoration; windows extend to crowns of side compartments and thus completely light the room. Instead of a complete vault, the central space is frequently enclosed by a wooden frame, against which t abut the marginal vaults, and it is then treated as a coffered ceiling or is filled by a large picture, composed to suit its location. On the edges of the outer compartments and on the ribs of the groined vaults are leaf mouldings or rounds, carried horizontally around the border of the middle space. Within this is an enclosing member,

[illegible] in a [illegible] [illegible], but will [illegible] lines and [illegible] [illegible] the [illegible] [illegible] of an entablature. In the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] are closed, these surfaces and the central space are [illegible] [illegible] [illegible] compositions. In contrast with these, the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

[illegible] [illegible] surfaces with figures, [illegible] [illegible] [illegible] (Fig. [illegible]). The surfaces may also be divided into a [illegible] and three small [illegible], the first being [illegible] to receive a [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] of leaves and flowers cover [illegible] of the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] and [illegible] like the [illegible] [illegible] the [illegible] [illegible] [illegible] [illegible] as if resting on [illegible]. The [illegible] [illegible] [illegible] [illegible] of [illegible] and [illegible] an [illegible] effect, which could [illegible] be [illegible] in [illegible] [illegible] by a [illegible] with [illegible].

[illegible] [illegible] of [illegible].

[illegible]. Rooms arranged in [illegible]

[illegible] rooms of [illegible] may [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. They may be [illegible] [illegible] joined, [illegible], [illegible] [illegible] [illegible] [illegible], or [illegible] [illegible] [illegible] [illegible] [illegible] and [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] examples. The arrangement of rooms as first mentioned [illegible] [illegible] [illegible] [illegible] [illegible], where [illegible] [illegible] ceiling of [illegible] [illegible] [illegible] [illegible] were covered by [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of the [illegible], that their [illegible] [illegible] [illegible] [illegible]. The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. The [illegible] [illegible] [illegible] a rich and architecturally beautiful [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible], [illegible] are found in basilicas by [illegible] [illegible] [illegible] and can [illegible] in Bologna [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible].

It was [illegible] [illegible] to combine various forms of vaults in a divided plan [illegible], [illegible] [illegible] ceilings [illegible] over different parts. A [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] in the [illegible] [illegible] [illegible] [illegible] [illegible]. Cross form [illegible] and [illegible] [illegible]

which projects little in a complete vault, but with inserted frame and raised panel may have the complete profile of an entablature. In the decoration, the different surfaces have a varied treatment in color and ornament. If ends of side compartments are closed, these surfaces and the central space are suitable for picturesque compositions. In contrast with these, the compartments and the triangles or pendentives receive a predominating ornamental decoration with ground tones of different colors. Many Renaissance decorations have in the pendentives shrines with figures, supported and accompanied by ornamental forms (Fig. 241). These surfaces may also be divided into a hexagon and three small triangles, the first being appropriate to recieve a figure. Such a decoration was employed in the portico of Villa Farnesina in Rome by Raphael. Painted garlands of leaves and flowers cover angles of the compartments and enclose the central surface. Panels have blue grounds and are treated like the sky, on them being represented the story of Psyche with figures soaring as if resting on clouds. The whole exhibits Raphael's sense of beauty and produces an enchanting effect, which could only be produced in similar decorations by a master with genius.

c. Connection of Apartments.

177. Rooms arranged in Suites.

Simple forms of rooms may in many ways be combined to form suites of apartments. They may be either directly joined, appearing as portions of an apartment, or be merely arranged in a series along main axes and connected by doorways, forming the separate divisions of a building. Thorough treatment of connection of rooms is not intended, but it will be briefly illustrated by some examples. The arrangement of rooms as first mentioned first appeared in many Renaissance basilicas, where with horizontal ceiling of central aisle, side aisles were covered by groined vaults or pendentive domes. The heavy loading of arcades by clearstory walls so nearly neutralizes the thrusts of the vaults, that their resultant is but slightly inclined. The necessary buttresses are included witnin the building to form recesses for chapels. The side aisles thereby has a rich and architecturally beautiful treatment, with an effective contrast to the spacious middle aisle. As in Early Christian models, the choir usually ends in semicircular form and is covered by a half dome. Beautiful examples are found in basilicas by Brunelleschi in Florence (with rectangular apse) and San Bartolomeo in Bologna (with ceiling lights in pendentive domes of side aisles).

It was most common to combine various forms of vaults in subdivided plans of rooms, using horizontal ceilings and vaults over different parts. A combination of groin and tunnel vaults was mentioned in the description of Roman halls. Pendentive or depressed domes form harmonious combinations with all

[illegible] [illegible] of the [illegible] [illegible] and covering the central part of the room, supported by four strong [illegible], they produce with adjacent [illegible] a [illegible] [illegible] [illegible] room. Thus the [illegible] of Vatican Museum with two [illegible] [illegible] and [illegible] dome, the whole being lighted by [illegible] [illegible] of [illegible] [illegible] [illegible], Fig. [illegible], [illegible] the central [illegible] dome is flanked by two [illegible] and extended in depth by a barrel vault, and [illegible] [illegible] [illegible] is extended on two sides by [illegible] [illegible].

[illegible]. [illegible] of [illegible] with Central Lighting.

If the central space be increased in height by placing a dome over it, and if on four sides lower barrel vaults or half domes adjoin it, this produces the grand and beautiful [illegible] [illegible] especially developed in [illegible] [illegible] as [illegible] [illegible] a centralized building. The central space [illegible] [illegible] [illegible] [illegible] one above the other; the lower part is square, with four piers connected by semicircular arches, either [illegible] [illegible], pendentives [illegible] [illegible] at top a horizontal circle and are crowned by a [illegible] [illegible] [illegible]. The

[illegible]

[illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] are [illegible] [illegible] [illegible] and the [illegible] and the angles are cut off by [illegible] lines, the pendentive [illegible] form [illegible]

[illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

of the [illegible] [illegible] in Cologne. This is [illegible] better suited to [illegible] a heavy and [illegible] superstructure, [illegible] [illegible] pendentives over a square [illegible] the circular [illegible] [illegible] the pendentives [illegible] a vertical drum and a dome resting on it. The drum must receive the thrust of the dome and therefore [illegible] has projections on its exterior to [illegible] the [illegible] of the dome appear light, and to admit light freely. If the pendentives are [illegible]

[illegible]

should have but a moderate height. Both the form of vault and the scale of [illegible] [illegible] [illegible], for construction may be executed securely in small

[illegible]

dimensions; but the resistance of the materials does not increase with the dimensions. It may generally be taken as a rule, that the higher the drum [illegible] dome are made, the more closely the plan of the pendentives should approximate to an octagon, when the heights are similar (Fig. 244). This produces proportions harmonizing with the construction and pleasing to the eye; [illegible]

proportions harmonizing with the construction and pleasing to the eye; [illegible]

[illegible]

and a corresponding [illegible] [illegible] [illegible] structurally in the [illegible]. [illegible] with the [illegible]. [illegible] openings are usually wide and require [illegible]

[illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

semicircular type of vaults. With a skylight and covering the central part of the room, supported by four strong piers, they produce with adjacent vaults a strongly united form of room. Thus the Bracchio Nuoyo of Vatican Museum with two tunnel vaults and half dome, the whole being lighted by skylights. In vestibule of Villa Madama, Figs. 242, 243, the central pendentive dome is flanked by two groin vaults and extended in depth by a tunnel vault; each room with groin vault is extended on two sides by large niches.

178. Connection of Room with Central Building.

If the central space be increased in height by placing a dome over it, and if on four sides lower tunnel vaults or half domes adjoin it, this produces the grand and beautiful combination especially developed in Renaissance churches and known as a centralized building. The central space consists of two forms placed one above the other; the lower part is square, with four piers connected by semicircular angles arches and supporting pendentives, which form at top a horizontal circle and are crowned by a bold terminal cornice. Surfaces of these vaults are portions of a spherical surface, when piersstand at angles of a square. But if the piers are partially moved into the square and its angles are cut off by straight lines, the pendentive vaults form peculiarly curved surfaces, which horizontally gradually pass from right lines into a circle. These surfaces overhang the less, the more nearly the plan of the room approximates an octagon. This is much better suited to support a heavy and large superstructure, than are regular pendentives over a square. Above the circular cornice of the pendentives rises a vertical drum and a dome resting on it. The drum must recieve the thrust of the dome and therefore usually has projections on its exterior to make the interior of the dome appear light, and to admit light freely. If the pendentives are placed over a square, this dome cannot exert a great vertical pressure on them, and should have but a moderate height. Both the form of vault and the scale of execution are decisive, for construction may be executed securely in small dimensions, but the resistance of the materials does not increase with its dimensions, but the resistance of the materials does not increase with its dimensions. It may generally be taken as a rule, that the higher the drum and dome are made, the more closely the plan of the pendentives should approximate to an octagon, when its heights are similar (Fig. 244). This produces proportions harmonizing with the construction and pleasing to the eye; diainproportions harmonizing with the construction and pleasing to the eye: diminishing the main sides of the lower part, arched openings become more slender and a corresponding form then results structurally in the superstructure. But with the square, arched openings are usually wide and require structurally and esthetically only a slight increase in height of the dome.

The following principles are applicable to architectural forms of the prin-

cipal space. Pilasters or columns are set in front of the four main piers and their entablature forms the impost cornices for main arches. This causes the construction to lose the impression of heavy massiveness, and it acquires a character of aspiration and support. The surface of each pier next the central space should have a niches with tablet or relief above it. In each pendentive surface a large circular space should be enclosed by a bold moulding, filled by a figure, the remaining angles recieve ornamental decoration. The upper limiting edge of this vault has a bold half round, above which is a vertical frieze, and the pendentives then end with a strongly projecting cornice of larger dimensions than the impost cornice. The vertical frieze prepares for the vertical surfaces above, so that by contrast of the strong cornice with the refined forms of the dome, its dimensions are apparently increased, and the base of the drum, whose simple form rests rather heavily upon the pendentives, is concealed from below. Above the plain base the drum has a series of pilasters whose height is two-thirds to one-half that of lower order. The intervals are arranged on the lower axes, contain windows with simple architraves, and are from eight to sixteen in number, according to height of dome and size of building. The dome is always subdivided to suit the arrangement of the pilasters, so that large spaces are above windows. In contrast to the lower architecture, the drum and dome should have a character of gracefulness lightness, assisted by colored decoration, the lower part having relief ornament to suit its bolder architecture. But pendentives are usually decorated by painting.

Rooms adjoining the central space have tunnel vaults and compose a cross form, in whose angles are usually placed smaller domed spaces connected with the side rooms by large arches(Connection with central space would weaken the piers or diminsih width of arches across arms of cross). Deco ive treatment of arms of cross follows that of central space. The order of pilasters extends in them and the tunnel vaults have coffers. The severe and heavy effect of coffers by contrast makes the decoration of dome appear lighter and more elegant. Instead of cross arms with tunnel vaults, semicircular apses covered by half domes and with gallery passages may adjoin the central space. The great pilasters in the central space must be omitted, or they must be made so slender and purely ornamental, that connection of architecture of central space with that of adjacent half domes is made possible. The centralized building, though having an ecclestiastical origin, is frequently used in secular architecture, if treated in accordance with a noble and ideal solution of the programme. "The whole should be essentially a building of purely esthetic aspiration for the architectural forms in themselves, just as well suited for every other ideal purpose as for divine service".

179. Heightening the Effect.

The different rooms in an architectural design may, as stated in Divisions 1 and 3, be divided into vestibules, communications, and principal apartments, according to their purposes. According to the importance of the rooms, a suitable gradation should appear in their decoration. In the order in which we pass through them to the principal apartment, there should be a transition from severe architecture of the exterior to elegant colored ornamentation. Therefore the vestibule and the entrance hall retain the character of the external architecture, and we economise decorative forms there, to heighten the effect in succeeding rooms by greater richness. Vestibules should be less strongly lighted than the principal apartment, to produce a gradual increase in lighting. The effect of rooms uniformly lighted by light from high above is materially increased if we enter through a darker vestibule. The highest effect in decoration and the most harmonious lighting is required in the chief apartments of the building. These should express in monumental designs the intellectual significance of the building, where the form of room, its decoration sculpture, and painting work together in a harmonious way.

DIVISION V.

VESTIBULES? STAIRWAYS, COURTS, AND HALLS.

By Professor Heinrich Wagner.

180. General.

Since the general designing of a building in plan, and section has been considered in the last Division, this last Division of Architectural Composition may then dismiss the arrangement of the building further, so far as it concerns rooms for common use, more or less developed in nearly every building, such as vestibules, stairways and courts. Designs for halls so commonly occur as entirely independent, or as portions of other buildings, that they are here subjected to general study.

The importance of stairways, vestibules, and courts, and their location and arrangement were discussed in Division 3 (Arts. 114, 126); their architectural treatment, with that of halls, was treated in the last Division. We now have to investigate their plans in general, their relations to each other, and to the principal parts of the building. From the intimate relation of these portions of the building, especially of the vestibules, stairways and courts, they cannot be separated, but are rather to be considered as a whole.

Chapter 1. Vestibules and Doorways, Entrance Halls and Corridors.

181. Diversity in Plan.

According to whether a building is to serve for public or private purposes, the plan of its ante rooms, vestibules, entrances, doorways, entrance

[illegible]ls, and corridors, also have to be treated in different ways. These are the [illegible] [illegible]

[illegible]

[illegible]

[illegible] [illegible] and [illegible] [illegible] the life of [illegible]

[illegible] These [illegible] [illegible] when [illegible] ahead of a public building, whose interior is always intended for the use of the external world. And since every prominent peculiarity should be reflected in the architecture, this would assume a more [illegible] in [illegible] entrance rooms of a private house, than in those of a public building. [illegible] [illegible] the corridors, which are the vestibules to each [illegible], but less [illegible] vestibule and [illegible] [illegible] to the interior of the building; least of all in buildings for large halls, the corridors [illegible] forming an [illegible] of the building outward, [illegible] a passage or corridor around it.

[illegible]

which in the [illegible] [illegible] free access of air and protection from sun [illegible] are [illegible]. [illegible] and [illegible] [illegible]

[illegible] of the building. Their place are to be considered in connection with the location of the entrance, on which the arrangement of all entrance rooms depends.

a. Flight of Stairs

[illegible] Porticoes, arcades, colonnades, etc.

[illegible] to buildings frequently [illegible] important rooms opening externally, [illegible] of ancient temples which project from the structural organism [illegible] [illegible] of the [illegible]. In Figs. [illegible] the portico is brought under the same roof with the temple cella, [illegible] also frequently extends [illegible] the places. In Fig. [illegible] it has the character of an enclosure, but in Figs. [illegible] and [illegible] [illegible] [illegible] requirement that such porches should not be set directly on the earth, but should be raised and [illegible] on a [illegible]; they would otherwise have the effect of [illegible] out of the ground and [illegible] [illegible] design would lose much in independent effect.

[illegible] importance was assigned to porticoes in the architecture of all periods [illegible] a public building [illegible], were [illegible] [illegible]. They were [illegible] covered by a horizontal ceiling or by vaults. [illegible] were either [illegible]

halls, and corridors, will have to be treated in different ways. These are the connecting rooms in the building, and their function is to facilitate passage from its exterior to its interior. This is true of both architectural treatment (Art. 179) and convenience of passage. They should harmoniously unite differences in form caused by external and internal influences, just as they lead from the hurry of the exterior to the life of the interior. This assumes that entrance rooms of a private house should be much smaller than those of a public building, whose interior is always intended for the use of the external world. And since every prominent peculiarity should be reflected in the architecture, this would assume a more purely internal character in entrance rooms of a private house, than in those of a public building. Especially in the corridors, which are the vestibules to each story, but less so in vestibule and entrance hall to the interior of the building; least of all in buildings for large halls, the corridors partly forming an extension of the building outward, partly a passage or corridor around it,

In such designs climate plays an important part, and the treatment must be arranged to suit it. Entrance rooms in northern countries must afford protection from rain, snow, and cold, and they must also be partially warmed, while in the warm countries free access of air and protection from scorching sun are required. Halls and vestibules may be treated with more beautiful and dignified effect, whose climate is mild and pleasant. Entrance rooms may then be more freely open, appearing better and more clearly on the exterior of the building. Their plans are to be considered in connection with the location of the entrance, on which the arrangement of all entrance rooms depends.

a. Plans of Halls.

182. Porticoes, Arcades, Colonnades, etc.

Entrances to buildings frequently form imposing rooms opening externally, like porticoes of ancient temples, which project from the structural organism itself, and are both simple and noble models of one story designs. In Figs. 245 to 247, the portico is brought under the same roof with the temple cell, sometimes at only one end, sometimes at both, also frequently extends along the sides. In Fig. 245 it has the character of an enclosure, but in Figs. 246 and 247 it is an open portico. It is an esthetic requirement that such porticoes should not be set directly on the earth, but should be raised and commence on a substructure; they would otherwise have the effect of growing out of the ground and would not appear like free artistic creations; their general design would lose much in independent effect.

Due importance was assigned to porticoes in the architecture of all periods; in scarcely a public building in antiquity, were they wanting. They were either covered by a horizontal ceiling or by vaults. Openings were either rect-

angular or arched, subdivided by piers or columns. These open porticoes (colonnades or arcades) are not merely in a single story, but also occur in several stories, according to whether, as in large Grecian temples, the external order occupies the entire height of the structure, only in the interior being two orders above each other, or whether the subdivision into stories extends to the exterior.

Excellent examples of the former are portico of Schinkel's Museum in Berlin (Figs. 91, 249), Klenze's Glyptothek in Munich (Fig. 248), Semper's Capitol in Winterthur (Fig. 206), and Hansen's Academy of Sciences in Athens (Fig. 252). Typical buildings of the latter kind, among other elegant creations of the Renaissance are Belvedere at Prague (Fig. 250) and Basilica at Vicenza (Fig. 251). The former was built by Paola della Stella after 1536 and is surrounded by porticoes; the latter has two stories of porticoes, Andrea Palladio having rebuilt the old Palazzo della Ragione as a "Basilica". The simple grandeur of the first strikes the eye; in the latter, the exterior consists of arcades, but has the genuine character of the portico, although dominated by the inner nucleus of the building in the most effective manner. Arcades or colonnades appear as projections or porticoes, and very frequently as loggias and recesses with closed ends. In all cases the porticoes serve to freely open externally the walls of the facade, sometimes in the lower story (Fig. 198), sometimes in the upper one (Fig. 206), also occasionally in several stories.

183. Street Porticoes and Verandas.

We find on many buildings, especially in southern countries, external porticos extending along the lower story, covered and forming open passages protected from sunshine, and syited for work and life in the open air, so dear to southern races. They also frequently occur in the German Renaissance. Streets occupied on both sides by high buildings, especially whose lower stories have porticoes or verandas, generally produce a heavy and unpleasant impression. Projecting structures of every kind, especially porticoes, are obnoxious to governments sometimes compelled to fight in the streets, or to march soldiers through them although such structures must have been common in many cities, where no longer found. For political reasons Rome and Naples have no street porticoes.

With these useful and often very picturesque designs, the principal entrance to the building is with difficulty recognized; the portico no longer invites entrance into the building; it even partially obstructs light to the rooms behind it. It is therefore customary to make them as light as possible, when such proticoes are built, (as for example at hotel "Frankfurter Hof" at Frankfort-A-M., Fig. 253, and the new arcades adjoining the City Hall at Vien-

[illegible] and even a few decades since, they were frequently employed, as in Rue de Rivoli and [illegible]

[illegible]

324. Connecting Porticos and Exoedras.

[illegible] on without enclosed rooms beside or above them, these erections belong to a class of especial importance. They usually also serve as the elegant [illegible] of buildings (Figs. [illegible]), or to extend them externally. The course of [illegible] buildings as well as with private houses. The porticos of Pompey and Octa- [illegible] baths, Gymnasium, etc., likewise played a great part in daily life.

[illegible] ra (Fig. [illegible]), which encloses the Piazza before St. Peter's Church in Rome. The front [illegible] is an elliptical enclosure with four rows of columns [illegible] The rear portion is enclosed by [illegible] straight porticos diverging towards the church, [illegible] A similar design, consisting of porticos of quadrant plan, was erected before Kasan Ca- [illegible] in honor of the victories of 1812-15.

[illegible]

[illegible] (by Davioud and Bourdais, 1878). The colonnades of the former (Fig. [illegible]) [illegible] central building, while those of Trocadero Palace are also utilized for exhibitions, and are enclosed at the rear by a wall.

325. [illegible]

[illegible] detached open loggias which especially occur in Italy, and which are to be considered as independent buildings. [illegible] is Loggia dei Lanzi in Florence (by Orcagna, 1376). [illegible] arch at each side, [illegible]

na, Figs. 254, 255). From the faults mentioned, such porticos have fallen into disuse in northern Europe. At the beginning of this century and even a few centuries since, they were frequently employed, as in Rue de Rivoli and other streets in Paris (Fig. 254), likewise in Carlsruhe, etc. With few exceptions (as the examples in Figs. 253, 254), they have been almost entirely replaced by modern street porticos and shops with large show windows.

184. Connecting Porticos and Promenades.

If porticos are only intended to form covered promenades and resting places without enclosed rooms beside or above them, these creations belong to a class claiming especial importance. They usually also serve as an elegant and architecturally effective connection between several buildings or parts of buildings (Figs. 253, 257), or to extend them externally. The courts of Egyptian temples were thus surrounded by porticos, as well as most public squares of the ancient Greeks and Romans, these being connected with public buildings as well as with private houses. The porticos of Pompey and Octavia in Rome were favorite promenades of wealthy youths. Those of the Forums, Baths, Gymnasiums, etc., likewise played a great part in daily life.

An example in the Italian High Renaissance is the noble portico by Bernini (Fig. 256), which encloses the Place before St. Peter's Church in Rome. The front portion is an elliptical enclosure with four rows of columns about an uncovered area, at its centre being the obelisk with fountains at each side. The rear portion is enclosed by simple straight porticos diverging towards the church to make the smaller place appear larger and deeper. A similar design, consisting of porticos of quadrant plan, was erected before Kazan Cathedral in St. Petersburgh, and Alexander I had it built by Varonikin in memory of the victories of 1812-15.

The same motive forms the basis of several examples produced in recent years, such as the porticos of the magnificent Palace of Longchamp near Marseilles (by Esperandieu, 1862-70), and those of the Palace of Trocadero in Paris (by Davioud and Bourdais, 1878). The colonnades of the former (Fig. 257) merely serve as promenades connecting the angle buildings with the central building, while those of Trocadero Palace are also utilized for exhibitions, and are enclosed at the rear by a wall.

185. State Porticos and Loggias.

To these architectural designs are to be added state porticos, which do not serve as promenades, but are chiefly devoted to public uses. Here belong detached open loggias which especially occur in Italy, and which are to be considered as independent buildings. One of the finest examples of this kind is Loggia dei Lanzi in Florence (by Orcagna, 1375). The three great arches with an arch at each side, in the facade of the loggia are of imposing dimen-

sions (Table, Art. 100), but are so elegantly treated and so intimately connected with the cornice, that the building is unsurpassed in this respect. Other porticos enclose tombs and courts of monumental cemeteries, also cloister courts, etc. Further discussion will be left to Chapter 3 (Plans of Courts) and pater volumes.

186. Treatment of Porticos.

In the treatment of porticos, especially of vaulted arcades, it is essential to devote the necessary attention to the endings at their angles, and it is usually advisable for structural and esthetic reasons to strengthen the supports there. This is generally done by placing columns, pilasters, or piers before the members supporting the arches. If porticos are arranged in several stories, care is usually taken to treat the lower story in forms suggesting greater strength, passing upwards into lighter forms. We may begin with the Doric or Tuscan Order; the Ionic will follow, then the Corinthian, perhaps caryatids or Hermes-like piers. The latter will have a good effect only when at a moderate height, for when higher from the ground, their detail forms will not be visible, and the artistic value of the figures will not have its full effect. For formal treatment of porticos, we refer to Part I, Vol. 3 of this Handbuch.

187. Galleries, Corridors, etc.

The use of externally open porticos and loggias is naturally limited in our climate (Germany). They are so much exposed to wind and weather, that when intended for connecting apartments, they do not accord with our views and customs. Yet the portico is such an effective element of architectural composition, that it must be regarded as indispensable. A simple means of employing them without these injurious effects, consists in treating the openings as windows and glazing them, otherwise retaining construction and treatment of the portico in all essential parts. This is now common, especially in new buildings. Even the famous Loggias of Raphael in the Vatican in Rome were enclosed, and their imitations, the loggias of the Old Pinacothek in Munich. These cannot produce the strong effect of shadow found in the open porticos. Their place was taken by glazed galleries and corridors, which otherwise exhibit the same monumental character. This is illustrated by Fig. 258, from Palace of Justice in Paris (by Duc and daumet).

b. Entrances and Doorways.

188. The Entrance.

The entrances are parts interposed between exterior and interior of the building. Entrances to buildings have been artistically treated from ancient times) The more conspicuously the mass of the building is treated, which separates the public square or street from the interior of the building, the great-

er is the need of emphasizing the connecting entrance. It should always be so treated that access through it to the entire interior of the building is evident, and one is not required to seek another entrance. Independent gateways are detached from the building or loosely connected with it, usually when the structure stands in the middle of grounds, or is built back from the street or road then requiring an enclosure, entered through the gateway. (Fig. 259).

189. Location.

The location of the entrance is of very particular importance; this was mentioned in Division III (Art. 126) as one of the chief points in arranging the system of passages in the building. As for the appearance of the building the portal usually is an artistic accenting of the principal axis of the structure. The entrance to the building should be recognizable at the first glance, and the axes of the principle facade, or those of the different prominent masses of the structure, are the places where they are sought and should be found.

It is not always possible to place the entrance at the centre of the facade. This occurs when all rooms in the front of the building must form a connected series, or when the length of the front is so small that a division in two halves would be unsuitable for rooms to be arranged at each side. The entrance is then placed left or right of the centre, frequently at one end of the facade, or often being even in one side of the building. The latter is permissible in short facades, especially in freely grouped structures, if the doorway is readily seen from the front. But the rear of the building is never suitable for the main entrance, only for entrance for purveyors, servants and private persons. In buildings at the corner of the street, it is usually best to arrange the entrance at the corner, especially when much used. (Art. 212; Fig. 305). If the structure surrounds a court, it is advisable to so arrange the entrance that one may directly pass from it into the court. This entrance will then be like a portico and is usually intended to be a carriage entrance.

190. Separate Entrances.

A single doorway is seldom sufficient for large buildings; several entrances are frequently necessary to lead to different parts of the structure, since they serve for varied purposes. With sufficient length of facade, they may then be symmetrically arranged on one facade, so far as they have nearly equal dignity. But it is frequently hard to adopt the latter arrangement to the requirement of recognition of the main portal, and with due regard to internal subdivision of the building. When several entrances are necessary, they are usually placed in different sides, if these are accessible.

Distribution of doorways to the principal and side facades, or the greatest possible division and separation of the several entrances is indispensable,

[illegible] of persons entering the building is for good reasons advisable [illegible]. This is the case with all designs, where great numbers of persons are to be admitted in brief time to the interior, or are to find exit [illegible].

[illegible] A separation of entrances for carriages from those for persons on foot, which is possible in various ways, especially by arranging the portal on the main axis for persons, placing the carriage entrance at one side, or [illegible]. [illegible] of a single facade, if other buildings closely adjoin both sides. [illegible] entrance for persons may be placed inside the carriage entrance [illegible] with [illegible] (Figs. [illegible]); in simple buildings a single doorway is usually provided for both purposes.

[illegible] The Portal.

[illegible]

[illegible] by architects in all the best architectural periods. In no other part of the building may be found such abundance of the most elegant creations. [illegible] the modern period has sought its models in the extremely varied and peculiar forms of Renaissance portals. Some examples are shown in Figs. [illegible], 202, 203, 204.

[illegible] Forms.

In regard to dimensions and forms of entrance doorways, in order to make [illegible] in proportion to other parts of the building, and by richer ornamentation, one must [illegible]. The architectural treatment of the doorway may partially express the [illegible]. If [illegible], the effect as if the building is intended to keep fast or hold of persons as [illegible] like prisons, [illegible] appropriate [illegible].

[illegible]

if separation of persons entering the building is for good reasons advisable or necessary. This is the case with all designs, where great numbers of persons are to be admitted in brief time to the interior, or are to find exit therefrom.

First is a separation of entrances for carriages from those for persons on foot, which is possible in various ways, especially by arranging the portal on the main axis for persons, placing the carriage entrance at one side, or the converse. Instructive examples are shown by plans of theatres, halls, concert halls, etc. (Figs. 178, 275, 312). This separation is more difficult on a single facade, if other buildings closely adjoin both sides. Yet the entrance for persons may be placed beside the carriage entrance and combined with that into a single entrance portico (Figs. 261, 254); in simple buildings, a single doorway is usually provided for both purposes.

191. The Portal.

The portal distinguishes the entrance and as an attractive and rich enclosure of the doorway should appear as a prominent part of the building. The general form and decoration of the portal have been treated with especial liking by architects in all the best architectural periods. In no other portion of the building may be found such abundance of the most elegant creations. The architecture of the modern period has sought its models in the extremely varied and peculiar forms of Renaissance portals. Some examples are shown in Figs. 194, 202, 203, 204.

192. Forms.

In regard to dimensions and forms of entrance doorways, in order to make them easily recognizable, they must be distinguished, both by prominent size in proportion to other parts of the building and by richer ornamentation, but must also appear as belonging to the entire building and intimately connected with it. The architectural treatment of the doorway may partially express the purpose of the structure. If an entrance is heavy, wide, and low, it has the effect as if the building is intended to keep fast of hold of persons as well as of things, like prisons, arsenals, etc. But if the entrance be light and lofty in proportion to its width, apartments may be expected within for magnificence and festal enjoyment.

A very characteristic form of free opening toward the exterior is common in portals of mediaeval churches and cathedrals, consisting in an arched treatment of the opening enlarged externally. No less characteristic and equally inviting is the arrangement of an outer gateway, whose plan is usually a half ellipse or oval, and which makes a kind of niche-like vestibule as a portal. Strongly covered members and recesses of many doorways and gateways result from the same esthetic feeling. Such views harmonize with another mo-

[illegible] vertical [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] palaces, parliament houses, and other state buildings, whose size and importance are to be made prominent.

282. Entrance porticos.

The entrance frequently leads through a covered portico, sometimes open and sometimes closed, either placed entirely before the facade, as in Figs. 246 to 250, or as in Figs. [illegible] [illegible] [illegible] [illegible] [illegible] vestibules, with angles in form of a triangle or pentagon, one side containing [illegible] [illegible] (Fig. [illegible]). Porticos may serve as entrances or gateways for carriages; they [illegible] [illegible] that one may enter the building with clean shoes. Covered carriage porches are preferable to carriage passages, which are easily exposed to draughts of air.

[illegible] Carriage Porches.

Placing the entrance beneath a covered carriage porch is preferable in palaces and large public buildings. Floors of such porches must not be elevated. [illegible] [illegible] all [illegible]. Fig. [illegible] ramps, and Fig. 255 is a carriage porch at an angle. Besides the ramps of the carriage porch, [illegible] (Figs. 252, 253), and these afford a welcome motive for architectural treatment.

Carriage porches are to be harmonized with the exterior of the building, [illegible] [illegible] of forms as the latter. If the carriage porch be only a protecting roof [illegible], it [illegible] [illegible] like a foreign element attached to it. The esthetic impression of [illegible] [illegible] [illegible] off is thereby injured.

[illegible] Carriage Passages.

Carriage passages or drives, and gateways, [illegible] [illegible] [illegible] a portico with colonnades or arches. If they [illegible] [illegible]

tive, revived into fashion very recently, for accenting doorways and porticos of monumental buildings. It consists in the Roman triumphal arch. It was used by Semper and others with more or less success on theatres, exhibition palaces, parliament houses, and other state buildings, whose size and importance are to be made prominent.

193. Entrance Porticos.

The entrance frequently leads through a covered portico, sometimes open and sometimes closed, either placed entirely before the facade, as in Figs. 248 to 250, or as in Figs. 260, 261 arranged entirely within the building between adjacent apartments. In both cases it is generally necessary to set the building back from the building line of the square or street as much as the depth of the projecting portion. Entrance porches are sometimes found on Gothic churches, with a plan in form of a triangle or pentagon, one side containing the entrance doorway, the two others being treated as openings for passage (Fig. 262). Porticos may serve as entrances or gateways for carriages; they then recieve different names according to their arrangement and have the advantage that one may enter the building with clean shoes. Covered carriage porches are preferable to carriage passages, which are easily exposed to draughts of air.

194. Carriage Porches.

Placing the entrance beneath a covered carriage porch is preferable in palaces and large public buildings. Floors of such porches must not be elevated. Ramps are arranged at each side, and must not be too steep, being the longer, the higher the carriage porch is raised. Fig. 264 shows an uncovered drive, and the ground story plan in Fig. 178 shows two with projecting roofs; Fig. 263 is a carriage porch with curved ramps, Fig. 266 is one with straight ramps, and Fig. 265 is a carriage porch at an angle. Besides the ramps of the carriage porch, it is customary to arrange steps before it on the exterior, (Figs. 263, 266), and these afford a welcome motive for architectural treatment.

Carriage porches are to be harmonized with the exterior of the building, and are therefore to be built of the same material and with the same treatment of forms as the latter. If the carriage porch be only a protecting roof supported by light iron columns, it merely appears as an accessory of the building, or like a foreign element attached to it. The esthetic impression of such treatment is seldom entirely pleasing. The effect of the entrance itself is thereby injured.

195. Carriage Passages.

Carriage passages or drives, and gateways, termed gateway porticos if sufficiently spacious, are enclosed by simple subdivided walls, or developed like a portico with colonnades or arches. If they are also used by persons on foot,

[illegible] by a corresponding projection, either by a raised roof, or by a colonnace (Fig. [illegible]).

The carriage entrance is then generally [illegible], so that carriages may pass around in the court of the building. If a large number of carriages is to be expected [illegible] [illegible] [illegible] [illegible] building, and will preferably be [illegible] [illegible] so, when the entrance at the sides or rear (Plan in Fig. [illegible]), or when the plan permits both to be connected together by a double entrance portico, or a carriage passage [illegible] [illegible] of the building (Fig. [illegible], [illegible]).

c. Vestibules and Entrance Halls.

[illegible]. The Vestibule.

The passage from entrance portico to interior of the building is formed by the vestibule or entrance hall. [illegible] [illegible] the street, court, or garden, [illegible] [illegible] [illegible] [illegible] and also frequently contains the stairway [illegible] leading to the upper stories ([illegible]).

In [illegible] in the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] form the passage to the rooms.

[illegible]. The Entrance Hall.

[illegible] [illegible] [illegible] [illegible] [illegible] the entrance hall [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] dence in decoration; it must not excel the apartments in this [illegible], and must not delay the visitor on its own account, but rather [illegible] [illegible] [illegible]

these are protected by a corresponding separation, either by a raised walk or by a colonnade (Fig. 287).

The carriage entrance is also generally an exit, so that carriages must turn around in the court of the building. If a large number of carriages is to be expected in both directions and at the same time, or if it is impossible for carriages to turn in the interior, separate carriage entrances and exits are advisable. These may be on different sides or on the same side of the building, and will preferably be so arranged, if the building site directly adjoins the street at the sides or rear (Plan in Fig. 185), or when the plan permits both to be connected together by a double entrance portico, or a carriage passage is provided at separate and suitable points of the main facade of the building (Fig. 288, 307).

c. Vestibules and Entrance Halls.

196. The Vestibule.

The passage from entrance portico to interior of the building is formed by the vestibule or entrance hall. By vestibule is not to be understood only the ante-room next the entrance, separated by this from external connection with the street, court, or garden, but it also signifies the hall, which forms a passage to the different rooms on the same level and also frequently contains the entrance to the staircase leading to the upper stories (Fig. 289).

In Italian palaces of the late Renaissance, the vestibule was much increased in size to accomodate numerous servants in attendance on visitors. The gateway was then treated as a carriage entrane and was made large and wide. Vestibules in Florence by Bramante were seldom more than a passage with tunnel vault, but became a larger and higher vaulted room. The vestibule became one of the highest problems, for the staircase (next Chap.) had before been merely dignified and convenient, was then presented to the eye and to the imagination as an element of beauty, and was directly included in the vestibule. The entrance hall became of equal importance with similar halls in northern and southern Germany. In the upper stories, this forms an ante-room like the hall on the ground floor, a corridor or passage to the rooms.

197. The Entrance Hall.

This ante room for passage will then be termed the entrance hall or vestibule, when especially spacious or remarkable, being usually designed somewhat like a portico, and frequently decorated by sculptured and painted ornamentation. As the first rooms entered by a visitor, the vestibule and entrance hall decide the impression made by the interior. If the building contains fesal apartments, the entrance hall must not be prominent for especial magnificence in decoration; it must not excel the apartments in this way, and must not delay the visitor on its own account, but rather by quiet and noble forms

of stone architecture and especially to the external architecture, prepare [illegible] for the increased effect produced by the internal execution of the apartments.

[illegible]. Vestibule.

The entrance hall is that room through which passage is opened to the principal portions of the interior (Fig. 277), but it is not usually a room for residence, only for passage, [illegible] sits. Being not intended for a continuous occupancy, the vestibule or entrance hall should be less lighted than the other rooms, where good lighting is a requisite. [illegible] and location and the carriage porch and other arrangements before the main entrance prevents direct lighting. The vestibule should be so arranged, if not square, the larger axis may have the direction of the depth of the building, the smaller axis being that of the facade or parallel to the front (Figs. [illegible]). [illegible] the same level as the portico or threshold of the entrance, then ascending by [illegible] the entrance hall at a higher level (Figs. [illegible]).

[illegible] also be arranged regularly on both sides of the principal axis. With two rows of columns, a central wider passage and two narrower side passages are arranged (Figs. 278, 281), but the entrance hall appears more dignified without dividing columns. The use of columns partially depends on the height which may be given to the entrance hall. If they are not to appear stumpy, relatively small height free columns are advisable, to produce a good effect by dividing the available space into several narrower spaces.

[illegible] height that the entrance hall cannot be made low. It is always desirable for the entrance hall to have a respectable height, and therefore it frequently extends through two stories. An entrance corridor is sometimes arranged [illegible]

[illegible]. Peculiarities.

[illegible] Without going into details of plans, a few typical examples are illustrated. [illegible] entrance halls [illegible]

of stone architecture and by similarity to the external architecture prepare him for the increased effect presented by the internal decoration of the apartments.

198. Treatment.

The entrance hall is that room through which passage is opened to the principal portions of the interior (Fig. 270), but it is not usually a room for attendants, only for passage, with a separate room for the porter added to the side. Being not intended for a continuous occupancy, the vestibule or entrance hall should be less lighted than the other rooms, where good lighting is a chief requisite; in palaces, it usually receives indirect light only, since its central location and the carriage porch and other arrangements before the main entrance prevents direct lighting. The vestibule should be so arranged, that if not square, its larger axis may have the direction of the depth of the building, its smaller axis being that of the facade or parallel to the front (Figs. 271, 273). It is frequently necessary to keep the part next the entrance on the same level as the portico or threshold of the entrance, then ascending by steps to those parts of the entrance hall at a higher level. (Figs. 271, 272).

By the rooms placed over the reception hall and the requirements for supporting them, one must be guided in the treatment of the entrance hall; it therefore frequently has columns, piers, etc., to support the ceiling, and these are to be arranged regularly on both sides of the principal axis. With two rows of columns, a central wider passage and two narrower side passages may be arranged (Figs. 272, 281). But the entrance hall appears more dignified if without dividing columns. The use of columns partially depends on the height which may be given to the entrance hall. If they are not to appear stumpy, for relatively small height free columns are advisable, to produce a good effect by dividing the available space into several narrower spaces.

In palatial buildings in southern Europe as frequently in Italy, the entrance hall occupies at least one and one-half stories, a mezzanine story being usually placed above the ground story, above which is the floor of the principal story; vaulting the rooms is customary in southern Europe and requires so much height that the entrance hall cannot be made low. It is always desirable for the entrance hall to have a respectable height, and therefore it frequently extends through two full stories. An entrance corridor is sometimes arranged in an upper story also, especially in the principal story, as in Fig. 274.

199. Peculiarities.

In many buildings entrance halls receive a peculiar treatment, required partly by local conditions (Fig. 105) partly by the special purposes they are to fulfil. Without going into details of plans, a few typical examples are illustrated. An important part is played by entrance halls in theatres and oth-

er buildings, intended to receive great numbers of persons. It is advisable, especially in northern Europe, to place wind screens at entrance doors leading to entrance halls. In entrance halls of theatres several entrance doors are arranged (opening outwards). If external walls are sufficiently thick to have sufficient space between doors placed at outside and inside of wall, the use of wind screens will be avoided; it is advisable to avoid an internal projection of wind screens by adding a separate thin wall in the entrance hall to form a vestibule, only beyond this wall treating the entrance hall as a united room. (Compare Figs. 275 and 178).

For churches it is appropriate to pass from exterior to interior through an enclosed vestibule, to protect the interior of the church from draugths, also providing an ante-room, where persons may form in processions before entering the church. A prominent part in modern architecture is played by waiting rooms of great railway stations. From their peculiar requirements and account of the enormous traffic, they sometimes have colossal dimensions and a peculiar development.

In English country houses, the entrance hall is generally an entirely closed apartment or noble hall that can be warmed, and in accordance with ancient traditions, it forms an indispensable part of the family residence, being accordingly decorated by paintings, arms, hunting trophies, etc., though frequently treated in a more simple and common manner (Fig. 276). A quite different character appears in the vestibule of French private residences. Just as nobly treated in its way as the English entrance hall, it does not produce the same impression of cosiness and comfort, but by its formal treatment always is a pleasing transition from the external architecture to the internal decoration (Fig. 277).

200. Waiting Corridors.

With vestibules and entrance halls belong waiting corridors, which are in France common in Court Houses, etc., the so-called Salles de pas perdus. These are long corridors to which the public is restricted, sometimes transacting necessary business with officials, sometimes awaiting an order to enter the court room. These rooms are high, airy, and are treated with massive richness, always with a severe character. (Figs. 278, 279). Many halls in other kinds of buildings possess a similar character (see Figs. 280, 317a).

Chapter 2. Plans of Stairways.

201. General.

"Very careful attention is required to designing stairways; for difficulties are great, to be overcome in giving them a suitable location, and one not injurious to the rest of the building. Praiseworthy are staircases that are light, spacious, and easy, thereby inviting one to visit the building".

In nearly these words in Chapter 28, Book 1 of his "Architecture, Palladio points out the chief requirements for these important connecting members of the structural organism. Very much depends on correct arrangement of the staircases. Yet this will be materially simplified by that said in the last Division in reference to planning the building in general, and that in Part III of this Handbuch on their arrangement and construction, parts in detail, and on external staircases. There remains the designing of staircases in the interior of the building, especially those of monumental character.

a. Forms of Staircases.

202. Historical.

To characterize staircases of different periods of art, the following points become prominent. In antiquity, staircases in the interior of the building could acquire no importance. Principal apartments were limited to the ground floor; stairways leading to upper stories were enclosed between walls, and appear to have received no architectural treatment, and were quite steep. This is assumed from the writings of Vitruvius (Book IX, Chap. II) and is proved by extensive and partially preserved staircases of Roman amphitheaters, planned with extraordinary skill, to provide access to all parts of the building for great multitudes of persons, with quick egress for them in the most perfect manner. Staircases of mediaeval buildings are generally placed on facades in open stairways or stair towers and mostly consist of winding steps. Desire for richer treatment appears everywhere under influences of late Gothic and Early Renaissance in numerous gracefully grouped and effective creations. The monumental stairways in interiors of buildings are among the creations of the Italian Renaissance, and they have been transferred to modern architecture without material change. Especially in public and palatial buildings, while dwellings have comfortable, and attractive staircases.

Stairs will be considered from the point of view of suitability, without reference to diversities in material, construction, and form.

1. Stairs in Straight Flights.

The steps of the staircase sometimes continue in one flight without interruption, but they are generally at proper intervals divided into separate flights by walking spaces or landings, with or without change in direction. The most varied forms result from influences affecting arrangement in the interior of the building, yet these may be classed under a number of simple types.

203. Straight Staircases.

The form most convenient and appropriate for ascent and descent is the straight staircase without turns from beginning to end. It may be enclosed between two walls extending beside the steps (Fig. 281) be built free on both sides in the

case (Fig [illegible]), or may be free on one side and built against a wall on the oth-
er (Fig [illegible]). [illegible]
[illegible]
wall. If the staircase must not appear very narrow in proportion to its length and height. If several staircases of this kind must be placed above each oth- er, [illegible]. If not required to economize space, the straight staircase is grand and simple in general effect and is not excelled by any other. It is therefore partic- ularly adapted to monumental buildings, either in single or double in plan, or may be arranged symmetrically to A B or C D (Figs. [illegible]).

One of the coolest structures of the first kind is the Scala Regia (Royal Stairs) (by Bernini) leading to pontifical apartments in Vatican at Rome (Fig [illegible]), which extends in a single flight for more than [illegible] ft. in length, and also appears much longer in perspective than is actually the case, for between the pair of columns its width at the lower end is [illegible] ft. this diminishes to 16.4 ft. at the upper end. A magnificent example of a straight [illegible]
[illegible]
that of the principal story.

Especially in entrances at upper ends of such staircases, they are furnished [illegible] or treated like porticos (Fig [illegible]), or are free above and are merely enclosed by balustrades near the staircase (Fig [illegible]). As a single staircase before [illegible] very frequently employed. (Fig. [illegible], etc.). This type is also used for ordinary [illegible] space.

[illegible]. Staircases in Several Flights.

[illegible]

[illegible]. Staircases in Two Flights.

[illegible] an interesting or even picturesque and effective view. [illegible]

room (Fig. 282), or may be free on one side and built against a wall on the other (Fig. 283). In all cases, particularly if the height is very great, this requires a great length of space, and in the first case a considerable width as well, if the staircase must not appear very narrow in proportion to its length and height. If several staircases of this kind must be placed above each other, the maximum distance must be traveled in passing from floor to floor. But if not required to economize space, the straight staircase is grand and simple in general effect and is not excelled by any other. It is therefore particularly adopted to monumental buildings, either is single or double in plan, or may be arranged symmetrically to A B or C D (Figs. 281, 283).

One of the noblest structures of the first kind is the Scala Regia (Royal Stairs) (by Bernini) leading to pontificial apartments in Vatican at Rome (Fig. 284), which extends in a single flight for more than 197 ft. in length, and even appears much longer in perspective than is actually the case, for between the pair of columns its width at the lower end is 27.5 ft. this diminishes to 16.4 ft. at the upper end. A magnificent example of straight double staircase was in Hotel de Ville in Paris, destroyed in 1871. Fig. 311 represents on one half, the plan of the ground story, on the other being that of the principal story.

Especially in stories at upper ends of such staircases, they are furnished with galleries to connect them with the adjoining rooms, and these are either treated like porticos (Fig. 311), or are free above and are merely enclosed by balustrades next the staircase (Fig. 281). As a simple staircase before halls, in entrance halls, in courts, etc., the straight staircase, as in Fig. 282, is very frequently employed. (Fig. 280, etc.). This type is also used for ordinary stairs with moderate height of story, if arranged along a passage required for communication or in a generally accessible space/

204. Staircases in Several Flights.

The direction may generally be changed for each flight between landings, producing staircases in several flights. If this change always occurs in the same direction, a simple staircase results, if in both directions, we have the double staircase in two flights.

205. Staircases in Two Flights.

The staircase in two flights is formed when the upper flight forms on the plan an extension of, or a right, acute, or obtuse angle with the lower flight, the latter are rare. The staircase in Fig. 285 is divided in two flights at right angles, and its entire length appears at a glance, the lower flight appearing in front view and the upper in side view. Suitable treatment produces an interesting or even picturesque and effective view. These advantages make the staircase very appropriate, where as in Fig. 276, it is built free in the

room and forms a part of its decoration. That it is suited to even monumental buildings is shown by Fig. 285, also by plans of the Palace of Archduke Ludwig Victor in Vienna (Fig. 185), and by upper and lower entrance halls of Capitol at Winterthur, furnished with two such staircases (Fig. 310d).

By far most comonly used is the half space staircase, as in Fig. 286; for it is easily and compactly arranged with rooms of ordinary depth, is enclosed by itself, permits access from principal landing to the different rooms in that story, and at the same time ascent to the next story takes the shortest way. This is the most appropriate form, though not the most elegant in its appearance, since the upper flight of the stairs usually appears from beneath a dark mass; and as it cuts across the opening at midheight of the story, it partially obstructs the view in the stairway. This frequently occurs in Italian palaces (Fig. 273). Flights of stairs are there quite broad and are mostly enclosed between side walls, each flight appearing by itself as in straight staircases. As a principal staircase extending from one story to the next, it ends above in open form; external defects then dissapear, and it is partly not visible on account of the enclosing walls and the ending of the upper part of the stairway, as shown by Fig. 286 (plan of ground story). It is often preferable to round off angles of the landing according to dotted lines in Figs. 286, 292.

206. Staircases in Three Flights.

Combining type forms in Figs. 285, 286 produces a staircase in three flights, as in Figs. 273, 287, a third short flight being added below or above to the half space stairs, usually at right angles to the middle string or wall, so as to begin or complete the ascent. This gives the lowest or second upper story greater height, without being compelled to require larger space for the stairway, with equal rises of steps. This form is likewise very frequent in Italian palaces. A good effect is also produced by three space staircase, which changes direction at right angles in Fig. 271, 288, especially if the second flight can have a greater length than the other two, producing a less obstructed view in the stairway (Fig. 277).

207. Staircases in Four Flights.

Likewise originated full space staircases, where as in Fig. 289, the flights from landing to landing turn at right angles, and end above the point of beginning. Staircases in Figs. 288, 289, are open towards the well-hole, and when several stories are arranged above each other, they recieve light through skylight. They therefore possess special advantages for location in the interior of the building, and as shown by numerous examples and by the given plans, they are capable of effective architectural treatment. Both forms demand rather more floor space than many others on account of well-hole enclosed by front

string, but they are otherwise easily arranged in plan, since they afford a suitable oppurtunity for varying ratio of length to breadth of stairway. But there is a minimum limit, fixed in accordance with Art.220, which is that not less than three or four steps must be placed between landings.

208. Staircases in Two Branches or Doubled.

The most diverse forms of staircases are produced from the simple type forms by doubling them on the axes of entrance hall or vestibule, and which are given by lines A B and C D in Figs. 281, 283 and 285. These compound forms require no extended explanation, being readily derived from the preceding, and their use in interiors of buildings will be treated hereafter. The most useful staircase in two branches is that formed from Figs. 285, 286 and 288 by symmetrical arrangement about the axis A B of the middle flight, with which it begins, and which is divided to right and left. Repeated on the axis C D, it may be termed a double staircase. Examples are the staircase in Fig. 290, that in Fig. 240, and that in corner building in Fig. 305; also in Fig. 307, etc. In Fig. 305 the entrance to ground story is found on bisecting line of the angle, and therefore in this direction is the entrance to the staircase, but the exits in upper story are on both sides perpendicular to corridors parallel to street facades.

It may be said with regard to these staircases in two branches, that their effect is more spacious and stately than that of simple forms, but the demand for space is correspondingly greater. And when space is not abundant, a simple and spacious staircase is decidedly to be preferred to one of two branches, restricted in plan (see Art. 221). Burckhardt says that a chief innovation in the architecture of palaces in Late Renaissance consists in doubling staircases for sake of symmetry, after men had already become accustomed to such in gardens and courts after Bramante. They either commenced below with two separate staircases, or one staircase was divided in two above the first landing. Great merit is due to Genoa with its steep flights of steps, where care must always have been taken to obtain for the numerous external stairways a good and beautiful effect.

2. Winding Staircases.

209. Simple Forms.

Instead of changing the direction from landing to landing, as in the preceding straight typical forms, this may also be effected from step to step by winding staircases with a solid newel or a well-hole. These are either entirely of winders, as in Figs. 293, 294, or partially so, but usually are enclosed by a semicircle. Winding staircases are easily adapted to either a semicircular or polygonal, an oval or rectangular room, and is therefore more read-

ily employed on an irregular building site, than are stairs of other types (side stairs in palace, Figs. 185, 186). They occupy least space on plan, and admit of access at any height and at all points of the perimeter; they are also the only form suited to any stride, since on the radial steps may be selected at pleasure any proportion of tread to fixed rise, both ascending or descending.

This type has the defect in case of small radius, that the change in direction from step to step is perceptible, ascent and descent being quite troublesome, but this almost entirely dissapears with a larger well-hole. On account of this difficulty the winding staircase is not employed where it is preferable for its other advantages, as when the arrangement of straight staircases is objectionable for local reasons (lack of space, irregularity, etc.). It was previously stated that winding staircases almost exclusively employed during the middle ages and the Early Renaissance.

As historical examples in Italian buildings, which seldom exhibit this typical form in the interior, are the circular staircase in Belvedere of Vatican (by Bramante, 1506), and the later oval staircase in Barberibi Palace in Rome (by Borromini), only differing from the former by its elliptical plan (Fig. 294). Both are of considerable dimensions (about 29.5 ft. in clear width); the hollow newell is composed of twelve Doric columns, which follow the helical curvature of the strings and balustrade. Among designs of allied type, though of different form, are the elegant winding staircases in middle and southern Germany, mostly of the 16th century (Fig. 298); then among numerous French examples of Early Renaissance is the beautiful newell staircase of Chateau of Chateaudun, of beginning of 16th century, Figs. 295, 297. Differing from most contemporary designs, the latter is enclosed in the building, permitting free passage between A and B.. The square plan is by conical vaults transformed into an octagon, and this into a a circle by the eight corbelled out columns supporting the helical cornice.

Modern architecture has rightly s changed to more simple forms of the stair-cases, at the same time with a practical limitation of their use. They are employed for minute uses in their most compact form as narrow isolated stairs with newells, but otherwise are only used for subordinate purposes, since they are entirely unsuitable for use by many persons. With a wide well-hole, they now occur as main staircases, usually in semicircular form, as in Fig. 291.

210. Compound Forms.

Winding stairs are suited to combine with straight ones. Most common is the type in Fig. 292, which may be placed in rooms ending in either rectangular, circular, or polygonal form, and which retains both the advantages and the de-

fects of the two forms composing it. It is appropriate where little space is available and an intermediate landing is omitted on account of low height of story, as in apartment houses and other buildings for purposes of utility. To insert a walking space in form of a sector of a circle instead of a few steps is more diturbing than advantageous, if the space is not wide enough to require at least two ordinary steps thereon (Art. 222). As main staircases, compound forms are usually arranged in two branches in monumental buildings. It is usual to commence with a middle straight flight, which branches from the landing in two curved arms (Fig. 298). Fig. 316 is a notable example. External straight flights of steps, much as usually entrance and exit steps, are usually constructed with more or less curved steps, gradually becoming wider (Fig. 177).

b. Arrangement and Form of Staircases.

211. Main and Private Staircases.

According to purposes and importance, main and private staircases are distinguished. The first is for public use in most buildings, but the latter is for private use and for the passage of the occupants. As a room for general use, the main stairway must be easily recognized and accessible; only in family and private residences is required a certain separation and isolation. But on entering public buildings, one should not doubt where to seek the main stairway. This does not alone usually suffice, since it generally ends free in the principal story, and it is desirable to so arrange that two flights may not come above each other.

To provide communication with the upper stories, side stairways are placed in larger buildings in addition to the main stairway, and these extend from cellar to attic. As service stairs, they provide servants with access to the housekeeping rooms, so that the main stairway is kept free; as stairs for private use, they are required to directly connect a series of rooms in different stories, but belonging together. Side stairs must sometimes serve for several of these purposes and be planned accordingly. But it is especially the main staircase whose suitable location and arrangement will cause difficulties.

1. Location and Direction.

212. Location of Principal Landing.

In harmony with the internal subdivision of the building, the main staircase is either located at an external side of the building, or more commonly at its center. It may then be partially or entirely surrounded by rooms. This is determined by the location of the principal landing, since accessibility of adjoining rooms is thereby fixed. If the principal landing lies in the interior of the building, then according to arrangement of entrance hall, the space in the ground story is divided in two equal parts, Fig. 299, or in two unequal ones, Fig. 300; both methods permit access to and from the staircase in the three

[illegible]
ings and stores, this separation is not objectionable, but it will frequently
[illegible]
facade to the side or rear beneath the intermediate landing is only permissible
[illegible]

[illegible]
an external wall, obtaining the advantage that the rooms form a compact
[illegible]
ment is preferred in French plans, even for main stairways of larger buildings, as it becomes possible to place the windows above principal landing at
[illegible]
Fig. 301. This has the defect that passage must be arranged around the stair-
[illegible]
apartments. It is therefore seldom arranged in this way (Fig. 302), but is preferable if (Fig. 303) it opens into a court surrounded by porticos,
[illegible]

The former arrangement is found in Austrian Museum of Art and Industry, Vienna (Fig 303); the latter occurs in hospitals, etc. According to Art. 152, intersections of compound ground plans are generally suitable for location of stairways.
[illegible]
-y interest), as indicated by dotted extension in Fig. 304. The principal
[illegible]
etc., and generally in all stairways placed entirely in the interior of the building. The last building shows that even for this location of the staircase, lighting by direct side light is possible. If the wings of the building form an angle, the staircase is sometimes placed on the line intersecting the angle.
[illegible]
staircase with two branches in Fig. 307. Among other advantages, the last are that of avoiding acute angles toward the stairway in Fig. 306,
[illegible]
must be provided.

312. Accessibility and Separation.

[illegible]

directions indicated. In most public buildings and in larger business buildings and stores, this separation is not objectionable, but it will frequently be very disturbing in private or apartment houses. Placing the entrance from facade to the side or rear beneath the intermediate landing is only permissible in ordinary or merely useful buildings, or in stairways of subordinate importance, according to Art. 189.

In smaller designs, the staircase and principal landing are placed against an external wall, obtaining the advantage that the rooms form a compact series (Fig. 301). Access to them can occur but in two directions. This arrangement is preferred in French plans, even for main stairways of larger buildings, as it becomes possible to place the windows above principal landing at the same height as other windows of the building. The same advantage is afforded by a location, Fig. 302, together with unbroken connection with all rooms, Fig. 301. This has the defect that passage must be arranged around the stairway, not only requiring much space but also a wider passage for reaching rear apartments. It is therefore seldom arranged in this way (Fig. 291). but is preferable if (Fig. 303) it opens into a court surrounded by porticos, or (Fig. 304) it gives access to several intersecting wings of the building.

The former arrangement is found in Austrian Museum of Art and Industry of Vienna (Fig. 337); the latter occurs in hospitals, etc. According to Art. 126, intersections of compound ground plans are generally suitable for location of stairways, lighted by sky lights, and also when wings of the building partially intersect, as indicated by dotted extension in Fig. 304. The principal landing may give access in the three directions toward the front and also directly sidewise to the passage to the rear. Thus in the School Building, Art. 131, and generally in all stairways placed entirely in the interior of the building. The last building shows that even for this location of the staircase, lighting by direct side light is possible. If the wings of the building form an angle, the staircase is sometimes placed on the line intersecting the angle. Here will be chosen either the arrangement in Fig. 306 or the staircase with two branches in Fig. 305. Among other advantages, the last has that of avoiding acute angles toward the stairway in Fig. 306, and one may enter from it either corridor of right or left wing. By arranging it as in Fig. 305 better lighting of the side corridor can be obtained, and a skylight must be provided.

213. Accessibility and Separation.

Various plans in Figs. 299 to 306 show the location to be assigned generally to the staircase with regard to greatest possible ease of access to the main part of the building. Therefore, in large blocks of houses, barracks, etc. staircases are repeated at fixed intervals, are externally accessible, and are

[illegible] This is more difficult and [illegible] [illegible]

[illegible]

and one can [illegible] see the route from the main landing.

[illegible] Beginning and Ending of Staircases.

It is usual to place the beginning of the staircase [illegible]

[illegible] If it occupies a part of the rear facade [illegible] Fig. [illegible] is [illegible]

the flight, a half turn is required at intermediate landing. In both, the beginning of the staircase is on the axis of the entrance of the building, the end [illegible] of the hall.

If one of the halls or principal apartments is required in the ground story, [illegible] of the staircase being placed on the transverse axis with a quarter turn to [illegible]

[illegible] direction of transverse axis. If (Fig. [illegible]) it must be accessible from both [illegible] building. In these and other cases, the plan is [illegible]

[illegible]

[illegible] Twin Staircases.

The same purpose is served by [illegible]

mostly of fire-proof construction. But with accessibility, separation is also necessary in certain cases. Especially in private residences and also in buildings ope to the public, like theatres, halls, post-offices, etc., it is important to arrange the connection with the entrance halls, so that those ascending and descending may be protected from draughts. This is more difficult and more necessary, since stairways extending through the entire height of the building are esstential for upward ventilation. Wind screens are placed at proper points to prevent draughts.

214. Direction.

Besides the location of staircase is to be determined the direction of the flight of stairs in different cases. Both on entering the building and on reaching the upper stories, one should not doubt how to turn to reach the rooms. This is best attained by ascending staircase directly from entrance without change of direction, and one can directly see the route from the main landing.

215. Beginning and Ending of Staircases.

It is usual to place the beginning of the staircase on one axis of the widely opened entrance hall, and that it may be more clearly seen, a number of steps someti are allowed to project into the hall. It is also desirable to have the last fligh of steps upward accord with axis of principal apartment of that story. Therefore if a large hall lies in the front of upper story, it is natural to make the arrang ment in Fig. 307; if it occupies a part of the rear facade, that in Fig. 308 is a s able one. In the last case, the room is reached without change of direction; in the first, a half turn is required at intermediate landing. In both, the beginnin of the staircase is on the axis of the entrance of the building, the end being on that of the hall.

If one of the halls or principal apartments is required in the ground story, this hall is preferably placed on the axis of entrance hall and entrance, the beginning of the staircase being placed on the transverse axis with a quarter turn to right or left (Fig. 310), so that wide passages beside the stairs (Fig. 308) may then form an attractive approach to the principal apartment, or staircases may be placed at each side of entrance hall (Fig. 272). The stiarcase is placed unconditionally in t direction of transverse axis, if (Fig. 309) it must be accessible from both front a rear sides, or a carriage passage, with which it is connected, leads through the building. In these and other cases, the plan is frequently symmetrically doubled about the principal axis, the entrance hall being in the ground story connected with two main staircases, which end in the upper story in a common hall (Figs. 310c 310d) or at opposite ends (Fig. 311) to make different parts of the building accessible.

216. Twin Staircases.

The same purpose is served by combining two staircases having a common intermediate landing, as arranged in a number of old and new buildings, and which may be

termed twin staircases. Thus Fig. 310e is one of the two main staircases of Technical High School at Charlottenberg executed with very imposing dimensions, and arranged parallel to main axis along the passages around the great inner court in center of the building and in two stairways, one above the other, to connect with the three stories. A person may start at A or B and ascend the staircase with a half turn in the direction of the arrow A-A or B-B, or travel in the approximately straight direction A-B or B-A. Also the main staircase of Opera House in Frankfurt -o-t-M (Fig. 314).

Two staircases may be combined in still other ways, when their junction is effected at the upper landing instead of on the intermediate one. This may be done when the principal story is two stories above the ground story. Since the staircase may terminate only in the main story, and in accordance with Art. 204, flights are not properly repeated above each other, the design must have such a length, that one must either ascend by a single staircase the entire height from ground story to principal story, which forms the second upper story, or reach the same point by two staircases placed behind or beside each other. The first leads from ground story to first upper story, and at its ending commences the second, which ends free in the principal story. The two stairways are thus placed in direct connection; one extending through the entire height of two lower stories, the other through that of two upper stories.

Such an arrangement is carried out in Technical High School at Munich, and is represented in Figs. 310a, 310b. The entrance to ground story is found on the main axis beneath the story landing. One may thence pass into the first upper story, or by the staircase divided in three branches, to the point lying immediately above it in the second upper story, where is the entrance to the large hall, or may change direction to right or left. The connection with the rooms in the rear is arranged in upper stories by halls at both sides and in ground story by one beneath the stairs.

217. Groups of Stiarcases.

Extraordinary numbers of people are to be assumed in many buildings, to ensure accessibility to all their parts in different stories. Particularly in theatres, concert halls, circuses, etc., it is necessary to regulate access of the public to different parts, especially to provide for quickly emptying the building, and this is done by separate fire-proof staircases, which occur in like number and arrangement of the main axis and lead to attractive entrances. (Plans of Leipzig Hall, Figs. 178, 181).

An example, where with reference to esthetic effect, both suitability and security were both taken into account in its design, is afforded by City Theatre at Riga, by Bohnsedt, Fig. 312. One may pass from entrance hall at p, and also from side entrance at p, to ground story vestibule and to landings at the same

height by means of the other ascents I, II, and III, which lead from the corresponding vestibules to staircases of the I, II, III tiers. These stairsa are both ingeniously and economically arranged as twin staircases (Art. 218) in three flights beside and over each other, but are separated from each other by massive partition walls and by landings. From the ground story upwards, the occupant of the I-tier uses the flight c, which terminates at x; that of the II tier first uses flight b, then a second flight carried over c, which likewise ends at x; finally, that of the III tier first ascends flight a, then a second over b and a third flight over c, to land at x. The crowding of the public is impossiboe if doors at y in the I and II tiers and those at z at height of the I tier are kept closed. Yet there must be opened between the acts, since no other staircases exist for passing from tier to tier and to the foyer over the entrance hall at height of the I tier.

In large theatres (Paris, Vienna, Frankfort-o-M, etc.) a central state railway is placed between the side staircases of the different tiers. In Fig. 313 (Grand Opera in Paris, by Garnier), the side staircases open freely into the halls around the principal staircase and serve for all tiers. The ground staircase is reached directly from main entrance on the direction of the axis and through the great entrance hall from carriages placed beneath the audience room, by two flights of stairs leading upwards. Both steps and balustrades are curved as shown to produce a pleasing appearance of the entire stairway design. In Fig. 314 (Opera House in Frankfort-o-M by Lucae) side staircases are placed in closed stairways. In both, ascent of the main staircase begins in direction of the main axis while access to the tiers and to the foyer is diverted to each side of the building, so that the staircases must turn at right angles to the axis.

The same requirements, direction of flights of stairs at commencement and ending, frequently leading to opposite points of the axis, occur in many other examples (Figs. 317, 317a). On the other hand, the conditions and space at disposal frequently demand that the ending shall be directly over the beginning (Fig. 315). It remains to refer briefly to certain peculiar forms, composed of winding and straight flights of stairs (Fig. 316). The two-branched portions of these two staircases are in semicircular form with winding steps. The plan shows them at height of the upper landing. This floor of the upper story is partially occupied by an opening to light the lower rooms by ceiling light. Therefore, the type of plan and combinations of the two staircases, one behind the other, is as here represented.

2. Arrangement and Treatment of Forms.

218. Space Required.

Based on investigations made in this Handbuch, staircases are to be arranged

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[illegible] produced according to the following principles.

The first requirement is that it be laid out [illegible] upon :-

1. Ground plan of staircase, whether open or enclosed.

2. Height of the story and width of staircase.

[illegible] Proportions and Design.

[illegible] with the [illegible], [illegible] a great height to be ascended [illegible] the length of the staircase on the plan is thereby given. The tread [illegible] path in accordance with the dignity of the [illegible] and with its height; they are to be made more convenient [illegible] or the greater the number of steps to be ascended in a straight line [illegible] in a single flight. [illegible] between first and second landings, and these steps have [illegible]. The staircase in the [illegible] steps [illegible] to [illegible] steps, averaging [illegible] from [illegible] to [illegible] [illegible] are [illegible] by the [illegible] system, while but [illegible] the long [illegible] horizontal [illegible] should have more than [illegible] steps in a single flight, and less than [illegible] [illegible] usually occurs, [illegible] flights of steps usually [illegible] to [illegible] steps each, having [illegible] inches rise for [illegible] [illegible] height [illegible] in the [illegible].

It is to be remembered that ratio of tread to riser runs to the same throughout. To effect this and to simplify the figures, it is recommended that heights of stories be made multiples of height of riser, and the length of a flight of stairs on plan be a multiple of the tread, then [illegible] heights of the [illegible] to vary slightly, [illegible] usually practicable. If the number of [illegible] has been fixed, then it is to be determined in accordance with the [illegible], the division into one, two or more flights with landings between them. In [illegible] the following points are to be kept in view.

[illegible] Length of Flight of Steps.

[illegible] distances between landings or length of a flight, the extreme limit is given by the [illegible] just given. The usual rule that from [illegible] to [illegible] steps should be allowed in a direct succession in a flight is entirely [illegible], but it is based on the usual height of story and of [illegible] also [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] flight [illegible] [illegible] [illegible]

and executed according to the preceding principles.

The space required is first to be fixed, and depends upon :-

1. Ground plan of staircase, whether single or double.

2. Height of the riser and width of staircase.

219. Inclination and Stride.

Commence with the rate of inclination, since for a given height to be ascended the length of the staircase on the plan is thereby fixed. The tread and the riser are both in accordance with the dignity of the staircase and also with its height; they are to be made more convenient for the longer flights, or the greater the number of steps to be ascended in a straight line. Thus the Scala Regia (Fig. 284) has 90 steps in a single flight, 41 steps being between first and second landings, and these steps have 4.75 inches rise to 20.5 inches tread. The staircase in the Ducal Palace in Genoa ascends 35.1 ft. from ground story to principal story by 80 steps, averaging 5.25 inches rise to from 18.2 to 17.7 inches tread, and these are interrupted by two walking spaces, while our more recent and less dignified monumental buildings seldom have more than 20 to 25 steps in a single flight, and less than 5.5 to 5.9 rise to 13.8 to 13.0 inches tread scarcely occurs; with a moderate height of story, two flights of steps usually suffice with 12 to 15 steps each, having 6.7 to 6.9 inches rise for 11.0 to 10.65 inches tread. For servant's stairs, 7.1 to 7.9 inches rise for 9.45 tp 7.9 inches tread are permissible, when height of story is not great.

It is to be remembered that ratio of tread to riser must be the same throughout. To effect this and to simplify the figures, it is recommended that heights of stories be made multiples of height of riser, just as the length of a flight of steps on plan is a multiple of the tread, thus requiring heights of the stories to vary slightly. (Not usually practicable). If the number of steps has been fixed, then is to be determinedin accordance with the chosen type, the division into one, two or more flights with landings between them. In fixing dimensions, the following points are to be kept in view.

220. Length of Flight of Steps.

As for distances between landings or length of a flight, the extreme limit is given by the examples and results just given. The usual rule that from 12 to 15 steps should be allowed in a direct succession in a flight is entirely correct, for it is based on the usual height of story and of riser, also requiring that at least one intermediate landing be arranged in main staircase in each story. The minimu length of flight is to be not less than three steps. Single steps should not be omitted to break a straight flight, since they are easioy overlooked, are disturbing, and may even become dangerous.

If several flights of steps extend above each other to the different stories

with appropriate arrangement of the plan and equal heights of stories, they must have corresponding head room; if heights of the stories differ bur little, then in lower stories one or two steps may be omitted from the flights and the width of landing increased accordingly. If the heights of stories are very different, typical forms of space stairs afford means of equalizing them, since in Fig. 309 the middle flight may be entirely omitted and to the landing be given the entire width of the stairway. If the ground story is higher than next story, this may be remedied by prefixing a flight at a proper place. But except for special reasons, equal lengths should be given to flights of steps placed over each other, to ensure that beneath the turns in the stairs there should remain sufficient head-room, not less than two-thirds to three-fourths the height of the story.

221. Width of Flight of Stairs.

The width of the stairs or length of steps is to be greater if enclosed between side walls (box stairs), than if open on one or both sides, and it must also be greater, the further the flight extends in a straight line. This is shown in Figs. 284, 311; it results generally that in monumental buildings a width of stairs from 8.2 to 9.84 ft. is not unusual, and in branched staircases the middle flight is generally still wider. There is also a minimum for stairs in two branches; for a certain width is necessary, even in a private residence, if it be used and is not to appear mean. This may be taken at about 6.56 ft. for the middle flight and at 4.92 to 5.25 ft. for narrower side flights.

222. Dimensions of Landings.

It is a rule for the landing, that its width is to equal the length of the step, or that of the narrower flight of steps in a staircase in two branches. But the depth of landing is to be proportional to length of stride, so that one may take two or three ordinary steps of 21.6 to 23.6 inches each on it. Only then will it make the ascent of the stairs easier, and it is therefore better to entirely omit the landing, than to insert it to the detriment of a proper rate of rise.

223. Lighting.

Lighting is of great importance for arrangement and appearance of the stairs, for a well lighted stairway makes an agreeable and charming impressi,n, just as a dark one produces an unpleasant and inharmonious effect. We naturally have then a feeling of insecurity in ascending or descending. Moreover the stairway usually serves also for indirect lighting of adjoining rooms. Therefore the stairway must under all circumstances have direct light and it should be lighted as abundantly as possible. The usual arrangement with the landing against an external wall causes the lighting of the stairway by side light,

the windows being placed at mid-height of the story, as in Figs. 299 and 300. This will therefore be made apparent properly by projecting the intermediate landing and stairway beyond the front of the building on the exterior; thereby obtaining more space for development of the design in the interior. But the windows of the stairway are not to be placed at the same height as those of the rooms; they should be placed above the principal landing and this should be against an external wall as in Figs. 301 and 302. For a landing or flight of stairs to cut across the glass surface of the windows is inappropriate and ugly.

In lighting by a skylight, it is to be remembered that if the staircase extends through several stories, intensity of the light in the lower story is naturally much reduced, and it is further greatly lessened by the shadows of the flights of stairs. As in Art. 207, not only must a plan suitable for admission of light be chosen, but the lighting surface must be made very large. Requirements frequently differ greatly and must therefore be obtained in different cases. In the staircases extending through the two lower stories of the Federal Capitol at Winterthur (Fig. 310d), the ground story is sufficiently lighted by the high side light passing down from upper stair hall through two openings in ceiling of lower hall, which together have an area of only 97.2 sq. ft., or about one-nineteenth of the floor area of the room. In the House of the Museum Society at Stuttgard (Fih 309) the area of skylight amounts to 172 sq. ft. or about one-seventh, and is admitted through well-holes between middle and side flights of the stairway; the last example also shows how sky light may be utilized for directly lighting adjoining rooms. In designs for sky lights, care must be taken to provide sufficient ventilation of stairway in accordance with Art. 103.

224. Treatment of Forms.

Variety in architectural appearance and effect of the staircase is first fixed by the ground plan. The staircase ascending in a closed stairway appears different from that combined into a spacious design with the entrance hall, portico, or porch. The treatment of the staircase hall is also to be distinct from that of the stairway. Treatment of the forms is very varied, according to whether flights of steps are entirely free beneath or are supported by piers, columns, or vaults (For vaults beneath stairs and their decoration, see Art. 172, Figs. 228, 229) or are supported by walls at one end of the steps, or extens between entirely solid walls (box stairs).

It is less necessary to consider differences in form produced by construction and building materials, as these have been discussed and have been illustrated by the examples. The balustrade or railing always follows the inclination and the changes of the flights of stairs. This is aided by regarding

each flight as a part by itself, for even with a considerable length, the different steps only appear as unimportant architectural members; by their numbers they aid one in estimating size of the room and height of ascent, the landing affording a necessary pause for the eye. The intersection of the flights and the inclined balustrade with the structural parts of the stair- [illegible] [illegible] proceeds is attained in no other way (Figs. [illegible]). If the staircase is [illegible] the construction of the stairs. The wall surface is divided in panels and is also animated by moulded joints or by horizontal bands and mouldings [illegible] at the height of the story. Smooth materials, capable of polish, and not readily injured by use, are especially appropriate therefor. If the flight must [illegible] walls, it is advisable to treat the latter in accordance with [illegible] into stories, disconnecting the strings and balustrades so far as possible. We should proceed thus, if as in Fig. [illegible], such free supports are required for supporting corridors or porticos which are frequently arranged around the [illegible] [illegible]

When the stairs end at the height of the story, the upper portion of the [illegible] [illegible] arranged on one or two opposite sides (Fig. 290), but usually on even three or four sides of the room (Fig. 211), and these not only serve for connecting surrounding rooms, [illegible] charming views in the stairway and of the persons moving thereon. Especially in this upper part, the stairway is frequently treated as a kind of corridor [illegible] ornamentation. The noblest architectural effect to be produced by combination of stairway and entrance hall has been most successful in numerous modern buildings [illegible] also Grand Staircases of the Opera houses in Paris (Fig. 213), in Vienna, at Frankfort a M (Fig. 214), etc. [illegible] new Palace of Justice in Vienna (Figs. 215, 215a) and others.

Chapter 3. Dealings of Courts.

[illegible]

each flight as a part by itself; for even with a considerable length, the different steps only appear as unimportant architectural members; by their succession they aid one in estimating size of the room and height of ascent, the landing affording a necessary pause for the eye. The intersection of the flights and the inclined balustrade with the structural parts of the stairway occassions difficulties. It is simples when the flight of steps is built free in the room and ends there, and the pleasing and quiet impression thus produced is attained in no other way (Figs. 310b, 317a). If the staircase is built against one wall, the subdivision of the latter usually follows the inclination of the stairs. The wall surface is divided in panels and is also animated by moulded joints or by horizontal bands and mouldings ending at the height of the story. Smooth materials, capable of polish, and not easily injured by use, are especially appropriate therefor. If the flight must be carried along a series or piers or a colonnade which replaces the solid walls, it is advisable to treat the latter in accordance with its division into stories, disconnecting the strings and balustrades so far as possible. We should proceed thus, if as in Fig. 308, such free supports are required for supporting corridors or porticos which are frequently arranged around the openings for the staircase. Treatment of the forms is most difficult, when intermediate strings must be supported by piers or columns with or without inclined vaults connecting them.

When the stairs end at the height of the story, the upper portion of the stairway is sometimes freely developed above (Fig. 240), or is sometimes surrounded by the corridors. According to requirements, these are not only arranged on one or two opposite sides (Fig. 290), but usually on even three or four sides of the room (Fig. 311), and these not only serve for connecting surrounding rooms, but also have a very fine architectural effect. They afford charming views in the stairway and of the persons moving thereon. Especially in this upper part, the stairway is frequently treated as a kind of corridor and is then usually furnished with appropriate paintings and other ornamentation. The noblest architectural effect to be produced by combination of stairway and entrance hall has been most successful in numerous modern buildings, designed after older Italian models. This is shown by the Angerer Palace in Vienna (Fig. 307) and Technical High School in Munich (Figs. 310a, 310b) also Grand Staircases of the Opera Houses in Paris (Fig. 313), in Vienna, at Frankfort-o-M (Fig. 314), etc. That a derivation of motives from the Italian cortile contributed thereto is shown by the Grand Staircase in state hall of new Palace of Justice in Vienna (Figs. 317, 317a) and others.

Chapter 3. Desings of Courts.

225. General.

Like all other uncovered parts of the site, which have the primary purpose of supplying light and air to the buildings. They frequently serve as a means of connection of the parts of the building on the ground level. This end is served by this area usually [illegible] laid out, treated and utilized, according to location, they are distinguished as fore, inner or rear courts and according to their uses and purposes, as [illegible] kitchen courts, courts of the offices, stable yards, etc. The latter courts serve only for purposes of utility, chiefly occurring in residences and farm buildings, therefore needing no discussion here or more than reference to their important place.

But the design of the former is required by the architectural importance of the court [illegible] forms an independent part of the entire building, frequently being given an internal [illegible] entirely or partially enclosed by [illegible], and it is sometimes roofed. This kind of court, which belongs to the entrance and passage rooms of the structure, remains to be described as supplementary to these. Its importance in architectural designing is self-evident, and this becomes more so by a brief retrospect of the historical development of courts.

[illegible]. Historical.

The dwellings of the ancients were furnished with spacious courts, enclosed [illegible] as [illegible]. These [illegible] and [illegible] the chief rooms [illegible] the court of a Greek house formed the central part of the building, of its life and activity. However simple the exterior of the house, the interior must have been rich and pleasing by the splendid effects of planting, by picturesque views in the courts, enhanced by ornamental shrubs and plashing water, and by porticos with their splendid paintings and sculptures. The atrium and peristyle were usually small courts in Roman houses. Several kinds may be distinguished, according to construction and arrangement, and they gave the [illegible] in which a refreshing fountain was placed when possible (Fig. [illegible]). Large courts were constructed in the baths of the Roman imperial period, partly as places for games, partly for other purposes, and they were furnished richly with statues and art works. These courts frequently ended in semicircular or segmental form and were generally enclosed by promenades or porticos.

The fore-court or atrium of the Early Christian basilica was usually surrounded by a portico and at its center stood a fountain for ablutions before entrance to the church. The atrium also served as a burial place (Fig. 311).

Like all other uncovered parts of the site, courts have the primary purpose of ensuring light and air to the buildings. They further aim to arrange a connection of the parts of the building on the ground level. This end is served by this area, usually uncovered, laid out, leveled and drained. According to location, they are distinguished as fore, unner or rear courts, and according to importance and purpose, as main or side courts, light or kitchen courts, courts of the offices, stable yards, etc. The latter courts serve only for purposes of utility, chiefly occuring in residences and farm buildings, therefore needing no discussion here or more than reference to their treatment later.

But the design of the former is required by the architectural organism of the work and forms an inseparable part of the entire building, frequently being even an internal room therein, when entirely or partially enclosed by the building, and it is sometimes roofed. This kind of court, which belongs to the entrance and passage rooms of the structure, remains to be described as supplement to those. Its importance in architectural designing is self-evident, and this becomes more so by a brief retrospect of the historical development of courts.

226. Historical.

The temples of the Egyptians were furnished with spacious courts, enclosed on two, three or four sides, sometimes by single or even by double porticos (Fig. 318). These externally closed fore-courts removed the temple proper and sanctuary from the view of the people, but gave place in Greece to the open temple precinct, access to which (Fig. 319) was sometimes through a lodge with portico and magnificent portal, or a propylea. The court of a Greek house formed the central part of the building, of its life and activity. However simple and tasteless the exterior of the house, the interior must have been made rich and pleasing by its splendid effects of lighting, by picturesque views in the courts, animated by ornamental shrubs and plashing water, and by porticos with their splendid paintings and sculptures. The atrium and peristyle were usually small courts in Roman houses; several kinds may be distinguished, according to construction and arrangement, and they were furnished with a water tank, in which a refreshing fountain was placed when possible (Fig. 320). Noble courts were constructed in the baths of the Roman imperial period, partly as places for games, partly for other purposes, and they were furnished richly by statues and art works. These courts frequently ended in semicircular or segmental form and were generally enclosed by promenades or porticos.

The fore-court or atrium of the Early Christian basilica was usually surrounded by a portico and at its center stood a fountain for ablutions before entrance to the church. The atrium also served as a burial place (Fig. 321).

The convents of the Orient were also furnished with similar fore-courts. [illegible] They were surrounded by buildings with openings [illegible] in the lower stories [illegible] into the halls and rooms of the monastery. [illegible] of the monastery; but fortified courts of military fortresses and castles appear otherwise, but belong to a different subject, which cannot here be pursued further.

But it is especially in the creations of the Renaissance, particularly in the courts of palaces and other prominent Italian buildings, where must be sought models for present use and for transformation of these elements of architecture. Consideration of a few typical examples will be useful in the following study of arrangement and treatment of courts.

a. Arrangement in General.

324. Location.

Courts are arranged in plan and elevation according to their purpose and to the conditions. [illegible] The arrangement and treatment are different [illegible] with regard to the position of the court to the rooms for communication, in order to bring the staircase into convenient connection with the court, the corridor or entrance hall should open towards the court, and [illegible] as possible. [illegible] entrances. Otherwise the location of the court and its connection with [illegible] determined by the form of the building, and [illegible] as required by a study of the design of courts.

325. Ground Form.

The rectangular plan is both simplest and most suitable. Yet, as in the following examples [illegible] It is usually best to give the court a regular form [illegible]. The court is sometimes open on one or more sides, [illegible] is entirely enclosed by buildings (internal courts). The surrounding parts of the building are also [illegible] sometimes in one, sometimes in several stories. The chief purpose of such courts, the possibility of introducing abundant light and air, is naturally best fulfilled by having at least one side freely open for their admission. In many kinds of buildings, as in hospitals and insane asylums, prisons, barracks, etc., as [illegible]

The mosques of the Arabs were also furnished with similar fore-courts. With these picturesque designs are included mediaeval cloisters. They were surrounded by buildings with cloister aisles in the lower stories, behind which were the halls and other rooms of the monastery. One of the finest examples exists in the Monastery of Maulbronn (Fig.322); the cloister adjoins the north aisle of the church and is enclosed on the remaining sides by halls and other rooms of the monastery. But fortified courts of mediaeval fortresses and castles appear otherwise, but belong to a different subject, which cannot here be pursued further.

But it is especially in the creations of the Renaissance, particularly in the courts of palaces and other prominent Italian buildings, where must be sought models for present use and for transformation of these elements of architecture. Consideration of a few typical examples will be useful in the following study of arrangement and treatment of courts.

a. Arrangement in General.

227. Location.

Courts are arranged in plan and elevation according to their purpose and to the conditions. The special purpose fixes the location before, within, or behind the building, then the formal treatment, and within certain limits, their space dimensions. The arrangement and treatment are different for a fore-court, from those of an inner-court; for a principal or state-court, or for a side or rear court. With regard to the relation of the court to the rooms for communication, in order to bring the staircase into convenient connection with the court, the corridor or entrance hall should open towards the court, and access to it is to be made as easy as possible. Side courts require separate entrances. Otherwise the location of the court and its connection with the plan depend on the form of the building, and it will here be only so far treated as required by a study of the design of courts.

228. Ground Form.

The rectangular plan is both simplest and most suitable. Yet, as in the following examples, polygonal, circular, elliptical, or other forms composed of straight lines sometimes occur. On irregular building sites, it is usually best to give the court a regular form.(Art.235 and Fig.333). The court is sometimes open on one or more sides, or bordered by promenades, and sometimes is entirely enclosed by buildings (internal courts). The surrounding parts of the building are also variously treated, being sometimes in one, sometimes in several stories. The chief purpose of most courts, the possibility of introducing abundant light and air, is naturally best fulfilled by having at least one side freely open for their admission. In many kinds of buildings, as in hosputals and insane asylums, prisons barracks, etc., no

other kind of court is permissible for sanitary reasons.

229. Dimensions.

Determination of its space dimensions is also of importance, especially in case of enclosed courts. If the buildings surrounding a court are very high and the court is not wide, sufficient light will not enter the lower rooms and the air stagnates and becomes impure in them. We therefore first consider the ratio of height to the width and certain minimum limits of these dimensions, not expressed in absolute numbers, but fixed with reference to climate and form used. Beneath the sunny sky of the South, shade and coolness are required, and in the inclement North, protection from wind and cold. Therefore much smaller dimensions suffice for the court in warm countries, than in cold regions, where it must be more open to the rays of the sun. It is generally assumed in Germany that the height of the building around the court should be about one-third the width of the court. This is only possible in rare cases and is only necessary, when the entire extent and height of the court are easily to be seen at a glance. Even then the given ratio is only to be taken as an average one. For a court arranged like a public square, serving for free entrance and surrounded by great monumental buildings, requires a greater width than that given. Thus the magnificent square court of the Louvre in Paris has for its side about 5-1/2 times the height of the lowest wing, built by Pierre Lescot under Francis I and Henry IV.

Yet a width equal to twice the height suffices for the court, when the observer can take a position to see perfectly and appreciate the entire architecture of the court facades. But this ratio is seldom attainable in inner enclosed courts. In Italy, where courts may be narrower, we find the width equalling or exceeding the height only in the grander designs. The proportion of equal height and width appears to have been intended in courts of some noted buildings of the Renaissance period. These are sometimes square, sometimes rectangular, as in the beautiful courts of Giraud, Farnese, and Borghese Palaces in Rome, and that of Hospital d. Incurabili in Genoa, while they are sometimes higher than wide, the elegant court of Cancellaria in Rome having the ratio of about 8 to 7, and the court of Strozzi Palace in Florence that of about 8 to 6. But in most Italian courts, the width is only from 3/4 to 1/2 the height, or even less.

As for the absolute dimensions of height, from observations in different acceptably lighted courts and from comparison, in Germany an architecturally treated court with minimum sufficient lighting should have a clear width of not less than 29.5 ft. to 32.8 ft. with a height of at most 39.4 to 52.5 ft. The eye can here see but a portion of the interior at a glance. With so great a height, it is necessary that light entering through glass roofs should in

[illegible] to be constructed by the principles of the [illegible].

[illegible]. Covers.

For courts enclosed by high buildings, the arrangement in Fig. [illegible] is also employed for better introduction of light by making the court larger at the top. If the court is rectangular, its ends may be higher than its sides, the given proportions may be approximated in this way.

c. Enclosed Courts Partially Surrounded by Buildings.

[illegible]. Fenced Courts.

[illegible] enclosures of [illegible] court [illegible] in front of [illegible] gateways, and within the enclosure or in areas connected [illegible] the building. According to the mode of enclosure, these courts are capable of the most varied treatment. Where the court adjoins an open square or street, the enclosure consists of a wall with or without entrance gateways, and where there is no wall, it has an enclosing fence of metal, wrought iron or bronze, of monumental design. Piers and columns supporting vases, spheres, etc., are placed at suitable intervals to decorate the fence, and their forms must conform to the architecture of the gateway. The portal [illegible] entrance [illegible] and forming rooms for the gate-keeper (Fig. [illegible]).

[illegible] or groups, fountains, etc., are equally appropriate for large courts of this kind. Where several courts adjoin, [illegible] open, [illegible] suitable for separating them, the impression must be that of a single court divided into several parts. For a [illegible], as well as to enclose the court, instead of a solid wall or open grille, porticos are arranged on one or more sides, especially on the front side and they are left open on both sides [illegible] of this occur in many buildings of antiquity and in [illegible] later being attached to [illegible], to exhibition buildings with arcades, etc. A most notable example of a large court surrounded by porticos is that of the National Gallery in Berlin (Fig. [illegible]). The [illegible] of the building and of its entire surroundings is made dependent [illegible] by the design of the court. [illegible] in this sense, architecturally [illegible] should likewise be considered as courts surrounded by porticos, passages, walls against which monuments are built, etc.

[illegible]. Fore-Courts.

But courts are not usually enclosed on all sides by mere fences, buildings adjoin them on one or more sides. This is the frequent arrangement [illegible] [illegible] ing directly on the street, it is not between the court and the garden. The

nowise to be obstructed by the structure of the roof.

230. Section.

For courts enclosed by high buildings, the arrangement in Fig. 323 is also employed for better introduction of light by making the court larger at the top. If the court be rectangular, its ends may be higher than its sides; the given proportions may be approximated in this way.

b. Enclosed Courts Partially surrounded by buildings.

231. Fenced Courts.

Permanent enclosure of a square makes it a court; access is obtained through gateways, and within the enclosure or in direct connection therewith is the building. According to the mode of enclosure, these courts are capable of the most varied treatment. Where the court adjoins an open square or street, the enclosure consists of a wall with or without entrance gateways, and where there is no wall, it has an enclosing fence of metal, either iron or bronze, of monumental design. Piers and columns supporting vases, spheres, etc., are placed at suitable intervals to decorate the fence, and their forms must be suited to the architecture of the gateway. The portal and carriage entrance are sometimes treated like a triumphal arch or frequently as deep gateways with living rooms for the gate-keeper (Fig. 259).

Decorations appropriate for open squares, such as columns, obelisks, statues or groups, fountains. etc., are equally appropriate for large courts of this kind. Where several courts adjoin, merely an open grille is generally preferable for separating them; the impression must be that of a single court divided into several parts. For a separation, as well as to enclose the court, instead of a solid wall or open grille, porticos are arranged on one or more sides, especially on the front side and they are left open on both sides or are enclosed by an external wall and left open next the court. Courts arranged thus occur in many buildings of antiquity and in recent structures, the latter being attached to casinos, to exhibition buildings with promenades, etc. A most notable example of a large court surrounded by porticos is that of the National Gallery in Berlin (Fig. 324). The temple-like appearance of the building and of its entire surroundings is made especially effective by the design of the court. Taken in this sense, architecturally treated cemeteries should likewise be considered as courts surrounded by portico-like passages, walls against which monuments are built, etc.

232. Fore-Courts.

But courts are not usually enclosed on all sides by mere fences, buildings adjoin them on one or more sides. This is the frequent arrangement found in palaces, noblemen's seats, etc., where instrad of placing the main building directly on the street, it is set between the court and the garden. Low

[illegible] buildings [illegible] from the [illegible] and [illegible] to the [illegible]
on the (Fig. [illegible]) [illegible] buildings [illegible]
the court on both sides, (Fig. [illegible]), while it is enclosed at the other side
by walls, [illegible] or porticoes. In [illegible] of [illegible] buildings; besides
[illegible]
etc. The advantages of this design, such as quiet location, distinguished
external appearance of the principal building, etc., are evident.

A still greater unfolding of effect, peculiar to the French palaces of
the end of the 17th century, is produced by arranging several successive courts,
formed by buildings on each side, almost next the square of the [illegible],
and diminishing in width toward the center of main building. The court of [illegible]
of Versailles is arranged with such an extremely magnificent and beautiful
effect (Fig. [illegible]), however erroneous its architecture may be in other respects.
[illegible]
enclosed by a rich grille, at the sides being the buildings originally intended
for ministers (Court of Ministers). A second court succeeds (Court of
[illegible]), then a third and still narrower court, which [illegible] of the [illegible]
and [illegible] of the King), next which were placed the sleeping
apartments of the King.

[illegible] Rear Courts.

Quite a different character [illegible] such [illegible] is
[illegible] by having the court behind the principal building, instead of
[illegible]. The first [illegible]
[illegible]
[illegible]
[illegible] gardens. This is illustrated by the Villa [illegible] (Fig. 197). Another
[illegible] is the court of Pitti Palace (Fig. [illegible]). At the [illegible] court
is placed the entrance to a more elevated garden, in a grotto-like niche [illegible]
decoration. The ascent to the garden is by means of steps [illegible]
[illegible]
or straight flight leads to the top. A court design of highest elegance is
at the charming Villa Pia in the Vatican. Fig. [illegible] is the ground plan, Fig.
[illegible] is a view of the oval court forming a terrace. In the rear and at one
end of the [illegible] is the Villa; in front and at the other end being
[illegible] opening [illegible] the sides by colonnades. This is externally [illegible]
[illegible]
[illegible] to which one may descend by ramps from two small and lofty [illegible]
[illegible] court. [illegible]
[illegible]
[illegible]
[illegible]
[illegible]

front buildings sometimes form the enclosure next the street or the passage to the facade, Fig. 325, but wings or subordinate buildings generally enclose the court on both sides, Figs. 327, 253, while it is enclosed on the other side by walls, grilles or porticos. In designs of larger buildings, besides the principal court, several lesser courts are provided, mostly for servant's use. The advantages of this design, such as quiet location, distinguished external appearance of the principal building, etc., are evident.

A still greater heightening of effect, peculiar to some French palaces of the end of the 16th century, is produced by arranging several successive courts, flanked by buildings on both sides, widest next the square or the street, and diminishing in width towards center of main building. The court of Palace of Versailles is executed thus with an extremely dignified and beautiful effect (Fig. 326), however monotonous its architecture may be in other respects. To the Chateau of Louis XIV (by Mansart), we pass through a great fore-court enclosed by a rich grille, at the sides being two buildings originally intended for ministers (Court of Ministers). A second court succeeds (Court of Princes), then a third and still narrower court, which again leads to the last and smallest court (Court of the King), next which were placed the sleeping apartments of the King.

233. Rear Courts.

Quite a different character, more attractive if less pretentious, is produced by having the court extend behind the principal building, instead of before it. We first consider thae arrangement introduced in Italian villa architecture, especially in Florence and Rome, where the court is combined with gardens. This is illustrated by the Villa Albani. (Fih. 199) Another beautiful example is the court of Pitti Palace (Fig. 328). In the background is placed the entrance to a more elevated garden, in a grotto-like niche being a fountain. The ascent to the garden is by means of steps winding around the grotto in quadrant plan; in the middle is a landing, from which another straight flight leads to the top. A court design of highest elegance is at the charming Villa Pia in the Vatican. Fig. 330 is its ground plan; Fig. 329 is a view of the oval court forming a terrace. In the rear and at one end of the smaller axis is the Villa, in front and at the other end being a portico opening along its sides by colonnades. This is externally in two stories and rises from the lower part of the design in the middle of a basin, down to which one may descend by ramps from two small and lofty portals flanking the terrace court. Courts of most palaces in Genoa have low buildings at the rear or open directly into gardens, which enrich the courts by special decorations and are also usually raised higher than the level of the court, thereby affording oppurtunity for decorating the rear of the court by terrac-

ed slopes and fountains. Where conditions of the ground permit, one should never fail to realize such advantages.

c. Enclosed Uncovered or Glazed Courts.

234. Courts with Porticos.

In this kind of court must be clearly retained the distinction in Art. 225 between courts for useful purposes and those serving both convenience and luxury. We will consider the latter. They are like the atrium of the antique house and are considered as an inner room thereof, if the rooms of the house open freely into the court or are connected with this by porticos surrounding it. While for fenced courts, or those but partially surrounded by buildings, walls, grilles, and porticos chiefly occur as enclosures; in internal and covered courts, they usually extend around one, two or more sides in each story so as to form a connection with the interior. This design was especially favored by the climate and acquired a typical importance as a cortile in Italian buildings.

235. Ground Plan.

Its addition to the ground plan gives rise to very different forms of plans, Figs. 331 to 337, which especially differ in their connection with entrance, and in the location of entrance, entrance hall and stairway. The staircase sometimes commences directly in the entrance hall before the court; it sometimes leads directly into it, and may lie at one side or on the main axis at the rear of the plan, etc. In the last case, it belongs as much to the court as to the adjacent parts of the building, and it is generally arranged in two branches in the buildings of the best Renaissance period and in later examples. These Italian models were imitated in many courts of the Renaissamce period in German free imperial cities, connected with the South commercially (Figs. 334-335). Like analogous French and English examples, these were modified to suit climate and customs.

236. The Elevation.

The elevation of this court with porticos and galleries corresponds to the division into stories and generally exhibits several stories of piers or columns of different orders set above each other, sometimes connected by horizontal entablatures or by arches, an arrangement, whose application to the exterior of the building has already been described in Art. 182. Loggias or galleries in the highest story usually have a colonnade with horizontal roof, while the lower stories have arcades. The reverse arrangement also occurs. In the first case, to retain the axial distances of lower story causes some difficulty, since colonnades with horizontal entablatures like the antique produce very wide intercolumniations. To avoid this defect, the colonnade sometimes extends through the two upper stories. This does

[illegible]

ry to be used in court designs, since the proportion of the upper order of [illegible] never be obtained in inner courts.

[illegible] arrangement in Fig. [illegible] is occasionally found, as in the court of [illegible] columns, which [illegible] subdivide the openings [illegible] were commonly [illegible], especially in [illegible], the upper [illegible] and the columns are spaced [illegible] the interior [illegible] correspond [illegible] to the lower axial divisions; but instead of the stone [illegible]. This arrangement is an entirely proper architectural one and scarcely [illegible] feeling, since it is based on the lighter forms of [illegible].

[illegible] courts surrounded by porticoes at the ground level, [illegible] all such courts are well [illegible] for the reception of monuments, ornamental fountains, statues, sculptures, and of col[illegible] [illegible] at least a view from the entrance [illegible] into the court, and enhance the picture by [illegible] through the entrance, which [illegible] in an [illegible] house.

[illegible]

In accord with their primary purpose, courts shall be freely open and [illegible]ally uncovered. Thus were they alone employed down to the most recent period. [illegible], especially for comfort and ostentation, as is the case in [illegible] [illegible]. Thus squares in the court of Louvre in Paris, the court of the Royal Place in Berlin, etc., which have the [illegible].

[illegible]

[illegible]

not a give a truthful impression of the internal arrangement and is scarcely to be used in court designs, since the proportion of the upper order of columns then require such a distant point of view for the observer, that it can almost never be obtained in inner courts.

But the arrangement in Fig. 238 is occasionally found, as in the court of Monastery St. M.della Pace in Rome, where on the lower arcade piers stand the cross-shaped piers of the upper story, their intervals being divided by slender columns, which merely subdivide the openings like window mullions. Still more commonly, especially in Tuscany, the upper openings are entirely undivided and the columns are spaced with wide intercolumniations corresponding to the lower axial division; but instead of the stone architrave, wooden beams are placed above them with strongly projecting cornices supported by rafters. This arrangement is an entirely proper structural one and satisfies esthetic feeling, since it is based on the lighter forms of wooden beams.

We have to mention courts surrounded by porticos at the ground level, their upper stories being enclosed. All such courts are very appropriate for reception of monuments, ornamental fountains, statues, sculptures, and of colored decorations even if in a limited degree. Without abundant means, we may at least create a view from the entrance hall into the court, and enhance the picture by planting this with ornamental shrubs, by designing a fountain or a niche with a figure or vase, on the axis through the entrance, which are motives seldom omitted in an Italian house.

237. Glazed Courts.

To accord with their primary purpose, courts shall be freely open and especially uncovered. Thus were they alone employed down to the most recent period. Yet courts surrounded by galleries, if constantly exposed to wind and weather, are not as well suited for ordinary use in colder nothern countries, especially for comfort and ostentation, as is the case in warmer southern regions. Therefore open loggias or galleries,which surrounded the courts of older Renaissance buildings, were later mostly enclosed (Art. 187), and they were almost entirely omitted in the works of the following period. Glazed corridors or entrance halls were introduced in their place. Men learned to treat courts enclosed on all sides without porticos and galleries, like the external architecture, and to give them a richer decoration and characteristic expression. This appears in the court of Louvre in Paris, the court of Old Royal Place in Berlin, etc., which have the greater area required for such treatment.

238. Glass-Roofed Courts.

By progress in all technical branches, men have been enabled in recent times, to entirely cover large sized courts with iron and glass, effect-

ively protecting them from injuries by the weather, and also supplying adjacent parts of the building with the necessary light. Ventilation is usually effected in glass-roofed courts through openings in their sides and roof, but it is sometimes materially aided by heating apparatus. The roofing and warming of inner courts not only produce greater comfort for the occupants, an advantage in cold countries not to be underrated, since alternate warming and cooling of external walls almost entirely dissapears, reducing loss of heat to a minimum, but heating of the internal rooms of the building is made easier and relatively cheaper. It has thus become possible to give courts of more recent buildings both an importance and such a treatment, without detriment to their main purpose, that they may be made approximately equal to the noble designs of antiquity and of the Renaissance period.

The structural organism and the treatment of forms are essentially the same as in those models, and the portico has particularly come into use. Differences in arrangement and treatment are produced by the varied purposes of our courts. Those courts are preferable found in buildings intended to fulfil the requirements of the modern era for purposes of trade and business, for public purposes, for assemblage of great numbers of men, etc. Their use is especially common in banks, post offices, railway stations, hotels, and places of amusement; also in court houses, legislative buildings, city halls, and frequently in school buildings, etc.

We have here to distinguish the following:-

a. The glass-roofed court, open to common use and accessible by carriages as in some hotels (Fig.228); it then forms an enclosed pyblic square or place, which usually has the same character as the architecture of the streets and is paved or asphalted.

b. The festival, state or show court, like a hall with a sky light, and thus really used as an internal apartment of the building, as in Austrian Museum of Art and Industry (Fig.337) in Vienna, hotel "Kaiserhof" in Berlin (Fig.338), Arsenal in the same city, Technical High School (Fig.310e) in Charlottenberg. The porticos and galleries of the court then combine with the entrance hall and stairway, are designed in harmony with internal treatment of the building, and are treated like rooms for communication, being decorated by mosaics, marble slabs or tiles or even as a kind of winter garden. If the staircase is built free in the court, (Fig.317) it may be designated as a stair-court.

c. Like market and business halls, the court may serve as a bazaar and be

[illegible]

[illegible]

[illegible] in Berlin (Figs. 507, 508), where the court is surrounded by galler-

[illegible]

[illegible]

[illegible]

[illegible]

but this does not prevent it in certain cases from occupying the entire height,

[illegible]

of buildings, here belong smaller and larger designs, whose lower stories

are used for business purposes, usually as glass-roofed apartments, and their

[illegible]

makes it possible sometimes to utilize the corridors on the ground level as

[illegible]

quired light and air. Many notable examples are found in business buildings

of the recent period. Other important court halls, as those of court hous-

es, post offices, city halls, etc., belong sometimes to one, sometimes to

[illegible]

[illegible] and by its arrangement, construction and form.

Chapter 4. Designs of Large Halls.

[illegible]

[illegible]

not the least of the rooms comprised in this division.

a. Typical Forms of Halls.

According to the special purpose they are to serve, halls exhibit great

diversity in [illegible]

[illegible]

240. Antique Basilicas.

The elongated building of simple rectangular plan first acquired great im-

[illegible]

surrounded by shops, vaults and warehouses; or it may be used as an exchange and exhibition hall and be correspondingly treated, as in House of Architect's Society in Berlin (Figs. 339, 340), where the court is surrounded by galleries in the two upper stories, communicating with adjacent apartments.

The last two classes generally require the entire ground area of the court only in the ground story with but moderate height, corresponding to its width and length. The glass roof then includes the second or third upper story, but this does not prevent it in certain cases from occupying the entire height, or the glass roof proper may be arranged above the roof surfaces of adjoining buildings. Here belong smaller and larger designs, whose lower stories are used for business purposes, usually as glass-roofed apartments, but their upper stories merely serve as light courts and sometimes have galleries. This makes it possible sometimes to utilize the corridors on the ground level as covered rooms, over a part of these introducing into upper stories the required light and air. Many notable examples are found in business buildings of the modern period. Other important court halls, as those of court houses, post offices, city halls, etc., belong sometimes to one, sometimes to another of the forms mentioned above, everywhere manifesting variety in purpose by the arrangement, construction and form.

Chapter 4. Designs of Large Halls.

239. General.

Every large internal room enclosed by walls and ceiling is termed a hall, whether it forms a separate structure or is an essential portion of the building. Many halls, especially those of extraordinary dimensions, are often briefly designated as "Halls", especially when they serve for general purposes. In nearly all prominent buildings for public and private use, the hall occurs with greater or less dimensions, sometimes as a room for general use, sometimes as a state apartment opened to a larger circle of visitors on festal occasions. Therefore the hall will be considered as the last, though not the least of the rooms comprised in this Division.

a. Typical Forms of Halls.

According to the special purpose they are to serve, halls exhibit great diversity in detail and in general in their forms. But certain principal kinds may be distinguished, and their types may ever be found in the noble buildings of antiquity.

240. Antique Basilicas.

The elongated building of simple rectangular plan first acquired great importance in the antique basilica. This became the motive for churches, cathedrals, and for numerous halls, in the later periods. The basilica is refered to Grecian origin; from descriptions of royal halls at Athens and in oth-

[illegible] by the Romans to covered halls adjoining the Forums, which served for most kind of [illegible] [illegible]

However it may have been with details of the design, it now appears to be [illegible] and usually with such a width that to cover it, it was divided by rows of columns or piers into three or five aisles. The middle aisle then was considerably wider than the side aisles (usually twice their width according to Vitruvius), [illegible] [illegible] were usually arranged over side aisles, the upper columns being lower [illegible] [illegible] which usually took the form of a semicircular or polygonal [illegible] frequently adjoined this. The basilica was generally covered by a horizontal ceiling, but was also vaulted.

The basilica [illegible] in Rome was of large dimensions (Fig. 241) and may be [illegible] [illegible]. The former is characterized by the omission of a terminal [illegible] by the employment of [illegible] [illegible] worthy of note in the plan of the Roman basilica is especially the extension of side aisles around all four sides. [illegible] That less characteristic is the basilica of Constantine, whose center [illegible] divided into three bays, the side aisles being covered by three barrel vaults at right angles to the axis. [illegible]

242. Baths of Rome.

[illegible] [illegible] of Caracalla and [illegible] of Diocletian in Rome. Fig. 243 represents the principal hall, [illegible] [illegible] instead of a [illegible] ceiling, [illegible]

er cities of Greece by Grecian writers, we may assume a certain similarity of their design, to the Roman basilicas. The name Basilica was first applied by the Romans to covered halls adjoining the Forums, which served for meetings of merchants, for sittings of courts of justice, and for public business of all kinds. Yet Roman basilicas are not built after a generally accepted model, any more than any other kind of buildings. The remains of pagan basilicas vary from the rules given for them by Vitruvius.

However it may have been with details of the design, it now appears to be settled that the Roman basilica was a rectangular hall, probably with closed sides, and usually with such a width that to cover it, it was divided by rows of columns or piers into three or five aisles. The middle aisle then was considerably wider than the side aisles (three times their width according to Vitruvius), and was almost always higher, so that a high side light could be introduced into the center aisle over roofs of side aisles. Galleries were usually arranged over side aisles, the upper columns being lower and with high balustrades next the center aisle. On the main axis and usually at one end, though sometimes on the side, was a raised space enclosed by balustrades, the tribunal, which usually took the form of a circular or polygonal niche. Subordinate rooms frequently adjoined this. The basilica was generally covered by a horizontal ceiling, but was also vaulted.

The Basilica Julia in Rome was of large dimensions (Fig. 341) and may be taken as a type of the true commercial basilica, but the Basilica of Constantine in Rome (Fig. 342) is to be considered as the type of an antique state hall. The former is characterized by the omission of a tribunal niche and by the existence of numerous subordinate rooms along the longer side of this five-aisled basilica with piers. Worthy of note in the plan of the Roman basilica is especially the extending of side aisles around all four sides. It is evident that the Basilica Julia could have had only a horizontal ceiling. Not less characteristic is the Basilica of Constantine, whose center aisle is covered by a colossal groin vault of 82 ft. span, divided into three bays, the side aisles being covered by three tunnel vaults at right angles to the axis. Their abutments recieve the thrust of the groin vaults; below their springing points were arranged projecting columns.

241. Halls of Baths.

Next to antique basilicas are the magnificent halls of the Roman baths, which have the same expression as the former. The same arrangement of the former. The same arrangement of the Basilica of Constantine is found in Baths of Caracalla and in those of Diocletian in Rome. Fig. 231 represents the principal hall, just as noble in effect as appropriate in construction. This makes possible vaulting instead of a wooden ceiling, securing a decid-

[illegible] in architectural treatment. [illegible] [illegible] [illegible] [illegible].

[illegible]. Roman Basilicas and Halls.

These examples show that the Romans knew how to develop the basilican and [illegible] [illegible] [illegible] [illegible] [illegible]. Some notes on designs of Roman halls are given by Vitruvius, who distinguishes Corinthian and other halls of great dimension, or halls with four columns, and Egyptian halls, for he describes the former as having a vaulted ceiling over single colonnades, and gives to the latter two colonnades above each other, covering that by an ornamental coffered ceiling with windows between the upper columns. [illegible] [illegible] [illegible] [illegible] give instruction to us based on experience.

[illegible]. Theatres and Amphitheatres.

Quite different from these halls, from which some beautiful [illegible], were those mighty creations of the Greeks and Romans, the theatre and the odeum, the amphitheatre, the hippodrome, and the circus. Although without roofs, or only covered by an awning, they should not be [illegible], since they are typical forms for our designs of halls, [illegible] [illegible] and the architectural works, where [illegible] came into use on the most imposing scale. They [illegible] [illegible] due to their uses, so that sometimes [illegible] or [illegible] [illegible] [illegible] [illegible] the circular building [illegible] [illegible] [illegible] in [illegible] works.

[illegible]. Centralized Buildings and Church Basilicas.

A very important transformation of this leading form occurred in Early Christian art, especially in ecclesiastical architecture. [illegible] buildings and [illegible] of the later imperial period [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

[illegible] [illegible] [illegible].

In [illegible] [illegible], the [illegible] [illegible] is at once [illegible]

ed advance in architectural treatment. The vaults of middle aisle rose so high above the side aisles, that as shown by the illustration, the hall was lighted by high side lights above side aisles.

242. House Basilicas and Halls.

These examples show that the Romans knew how to develop the basilica and transform it into a state hall. As such, not only in palaces for monarchs, but also in private houses for festal gatherings. Some data on designs of Roman halls are given by Vitruvius, who distinguishes in dining and other halls be tween Corinthian, or halls with four columns, and Egyptian halls, for he describes the former as having a vaulted ceiling over simple colonnades, but gives to the latter two colonnades above each other, covering them by an ornamental coffered ceiling with windows between the upper columns. In regard to halls for paintings, it is only stated that like halls for speaking, they were larger. Halls for speaking in gymnasia were large open halls attached to colonnades and furnished with seats, so that philosophers could give instruction to or amuse an audience.

243. Theatres and Amphitheaters.

Quite different from these halls, from antique house basilicas and commercial basilicas, were those mighty creations of the Greeks and Romans, the theatre and the odeion, the amphitheatre, the hippodrome, and the circus. Although without roofs, or only covered by an awning, they should not be neglected, since they are typical forms for our designs of halls, nearly relating to them in purpose and form, and are also the architectural works, where the circular building came into use in the most imposing manner. They differ in arrangements due to their uses, so that sometimes semicircular or circular plans appear most suitable, sometimes oval or a more elongated plan. In varied and entirely enclosed rooms, the circular building sometimes produces a peculiar effect in noble works.

244. Centralized Buildings and Church Basilicas.

A very remarkable transformation of this leading form occurred in Early Christian art, especially in ecclesiastical architecture. From Roman state buildings and monuments of the later imperial period was derived the centralized buildings in Byzantium under the influences of oriental architecture, and in the West were produced the basilican churches, doubtless by transformation of the pagan basilicas for Christian worship.

Since we do not have to consider church architecture here, it will only be necessary to refer to the centralized or basilican form of church, so far as in its chief peculiarities may be recognized elements of forms of halls in secular architecture.

In centralized buildings, the peculiar ground form is at once apparent,

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] (Fig. [illegible]) [illegible] [illegible] primary spaces with other chains and [illegible] spaces. The subordinate buildings in Fig. 288 are also noteworthy. The architectural treatment receives extremely effective and characteristic expression by the substructure, manifested in varied grouping of the principal dome rising above the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] (Figs. [illegible] to [illegible]).

The arrangement of the early Christian basilicas was at first like that of the pagan basilica, but gradually deviated more or less in construction and plan. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] of the [illegible], the [illegible] of [illegible] [illegible] [illegible] dome over the intersection, the projection of the apse and the development of the raised choir, the later addition of towers, etc. So far as the interior is not vaulted, the ceiling has coffers, is ceiled, or the frame-work of the roof remains visible.

[illegible]. Medieval Halls.

With this reference to ecclesiastical architecture, it should not be said that forms of halls in secular architecture found separate development. Especially in the middle ages, the perfecting of vaulted construction exerted a great influence upon treatment of the hall in the palace and in the monastery, in the castle and in the city hall, even though wooden beam ceilings and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] those halls and for lower rooms, where vaulting did not seem advisable or necessary.

The growing economy felt the continually increasing importance of city [illegible] and of the ecclesiastical orders, and required new buildings with great halls, which the masters of Gothic architecture knew how to adorn with great beauty and elegance. New motives and charming art forms were produced in stone, wood, and bronze, with no really new ideas in construction. Only the mode of lighting can be so designated, in halls of wide span. In case of vaulted ceilings, this was by means of large pointed windows, crowned by semicircular arches, which intersected near the top of the vault. With wooden ceilings the light was introduced through lateral windows, sometimes between [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] ceiling, which was usually of semi-cylindrical form. The usual arrangement of windows [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] vaulted halls and for those with wooden beam ceilings.

[illegible]. Halls in Renaissance and Modern Periods.

The architecture of the Renaissance is also [illegible] rich in [illegible]

and it is sometimes composed of a regular polygon, sometimes is in form of a Greek cross with merely nave and transepts, or (Fig. 343) consists of a primary square with outer aisles and semicircular apses. The subordinate buildings in Fig. 343 are also noteworthy. The architectural treatment receives extremely effective and characteristic expression by the superstructure, manifested in varied grouping of the principal dome rising above the whole, as well as in vaulting the aisles and corner buildings in two stories (Figs. 58, 63 to 66).

The arrangement of the Early Christian basilica was at first like that of the pagan basilica, but gradually deviated more or less in construction and plan. We may emphasize as essential changes and extensions architecturally, the prefixing of the atrium, the occurence of transepts with or without a dome over the intersection, the projection of the apse and the development of the raised choir, the later addition of towers, etc. So far as the interior is not vaulted, the ceiling has coffers, is ceiled, or the frame-work of the roof remains visible.

245. Mediaeval Halls.

With this reference to eclestiastical architecture, it should not be said that forms of halls in secular architecture lacked separate development. Especially in the middle ages, the perfecting of vaulted construction exerted a great influence upon treatment of the hall in the palace and in the monastery, in the castle and in the city hall, even though wooden beam ceilings and visible roof trusses remained in use as before, both for covering very wide halls and for lower rooms, where vaulting did not seem advisable or necessary.

The growing community felt the continually increasing importance of city affairs, and of the ecclestiastical orders, and required new buildings with great halls, which the masters of Gothic architecture knew how to adorn with great beauty and elegance. New motives and charming art forms were produced in stone, wood, and bronze, with no really new ideas in construction. Only the mode of lighting can be so designated, in halls of wide span. In case of vaulted ceilings, this was by means of large pointed windows, crowned by external gables, which intersected near the top of the vault. With wooden ceilings the light was introduced through luthern windows, sometimes between the visible trusses,, sometimes through sky lights in the wooden ceiling, which was usually of semi-cylindrical form. The usual arrangement of windows for low side light was in most common use, both for vaulted halls and for those with wooden beam ceilings.

246. Halls in Renaissance and Modern Periods.

The architecture of the Rena issance is also inexhaustibly rich in this

[illegible]

[illegible]

2. Arrangement and Form of Halls.

148. Classification of Halls.

To whatever use [illegible] buildings halls may be attached, they may be divided into the following groups, according to the chief purposes they are to serve:

I. Halls for the purpose of seeing and hearing well.

II. Halls for assemblies, festivals, exhibitions, etc.

III. Halls best adapted to fulfil all these purposes.

The arrangement and form of halls are therefore primarily subject to one or more of these requirements, and to the conditions of the position. [illegible]

3. Limitations of Sight and Voice Range.

149. Acoustic and Optic Centres.

[illegible]

respect, not only in fanciful ornamentation, but also in refined development of construction and forms of halls. They were indispensable to every prominent building; according to Palladio, "like public places, which serve for festivals, feasts, presentation of comedies, weddings, and similar amusements, they are therefore larger than the others, and must have that form best suited for many persons to comfortably occupy them and see the proceedings". If this primarily means the hall, which " all well arranged houses have in their central and finest part," it no less relates to halls in the palace and the villa, as well as to well known large halls of Italian municipal buildings and courts of justice, and to old city halls, commercial halls, pleasure houses, etc., in Germany and other countries.

But the modern period makes the most extensive use of halls. For in every sphere of life, in the state and in the community, in art and science, in trade and travel, in the great world and in simple family life, the restless activity of civilization has created new arrangements and improvements and caused new needs and views, embodied in new works of architecture. The design of halls is always of decisive importance. As in older models, designs of halls now produce the principal types of the basilican, and of the centralized building, the latter being subdivided into polygonal, circular, and cross forms. It remains to examine how these transmitted forms harmonize with the aim and purpose of our buildings.

a. Arrangement and Form of Halls.

247. Classification of Halls.

To whatever kind of buildings halls may be attached, they may be subdivided into the following groups, according to the chief purposes they are to serve:-

I. Halls for the purpose of seeing and hearing well.

II. Halls for assemblies, festivals, exhibitions, etc.

III. Halls best adapted to fulfil all these purposes.

The arrangement and form of halls are therefore generally subject to one or more of these requirements, and to the conditions of the problem. The design of the second kind of hall admits of greatest freedom and that of the first hasthe least; limitations also extend to halls of the third group. If a room completely fulfils the requirements of good hearing and seeing, it will not generally be difficult to satisfy all other requirements of the design.

1. Limitations of Space and Main Form.

248. Acoustic and Optic Center.

An acoustic and optic center exists in halls intended for good hearing and seeing. In halls for lectures and addresses, it is indicated by the speak-

er's desk; in concert and theatre halls, it is located in the orchestra, or on the stage near the foot-lights. In designing a hall, it is necessary to commence at its acoustic or optic center, and the plan or arrangement of the auditorium or space for spectators are made afterwards. It is evident that an arrangement suitable for the space for hearers or spectators differs much from those suited for the acoustic or optic center, or for the stage. Distinct perception of tones or of the object to be seen by direct rays is only possible within a limited distance from the source of sound or location of the object. These limits are therefore of supreme importance in halls of this kind.

249. Limits of Good hearing.

The limits of good hearing in the quiet open air have been fixed by experiment. Without further discussion we refer to Fig. 344, where these limits are graphically represented, assuming the speaker to be placed at C. The full line indicates the limit for good hearing in all directions from the speaker in accordance with the well known experiments by Saunders; those of Henry do not materially differ. On the basis of those and similar results, Orth and also Favaro give the simple form of a circle of 131 ft. diameter drawn through points respectively distant 98.4 and 32.8 ft. from the point O, as a limiting line with equal intensity of sound. Even if only approximately correct, yet for our purpose this circle is a sufficiently accurate representation of the limit.

Although diffusion of sound is quite otherwise in an enclosed hall filled with people, than in the quiet open air, where the observer is disturbed by no one, though the influences which result are partly beneficial and partly injurious to distinctness of perceptions of tones, we must accept these results for lack of other data. These are then the limits of good hearing, when the effect of the voice or the tone is not strengthened by artificial means. When these are employed, the limits may be extended much further; but they are to be made much less, if injurious effects of sound are produced.

250. Ground Form of Hall.

The form of space for the audience is derived from the preceding, together with other laws for diffusion of sound. The more closely this form approximates to these distances and limits, within which the voice is heard in all directions with approximately equal distinctness, the better will the room be adapted for good hearing. It follows that the most suitable ground form for halls of this kind is that approximating a circle, after the model of the Grecian theatre, which is chiefly enclosed by a circle. Starting from this basis, the ground forms in Fig. 345 were developed. Beyond the limits of good hearing, the tones are no longer distinctly perceptible by direct

[illegible] the examples in Fig. [illegible].

§ [illegible]. Acoustic Niches.

[illegible] of the locality of the source of sound. This purpose usually is served by a particular space, freely open toward the audience, of a form adapted to give to the sound rays a certain guidance and a certain initial direction, at the same time strengthening them. This may be termed the acoustic or sound niche. Such an extension of the room does not always occur, because the acoustic center is located within the hall itself, either since the addition of a sound niche is usually not practicable, the hall being not exclusively intended for the purpose of good hearing, or for the mode in which it is to be used, a single [illegible]

[illegible]. Other means for Good Effect of Tone.

[illegible]

as therefore to be utilized in designing the hall, since sound waves [illegible]

[illegible]

so be cut off parallel to the middle axis.

If the preceding principles are decisive in fixing [illegible]

[illegible]

rays and the form is determined in accordance with the influence of the enclosing surface of the room upon diffusion of sound. The same is true of the examples in Fig. 347.

251. Acoustic Niches.

In most intimate connection with the form of space for the audience is that of the locality of the source of sound. This purpose usually is served by a particular space, freely open toward the audience, of a form adapted to give to the sound rays a certain impulse and a certain initial direction, at the same time strengthening them. This may be termed the acoustic or sound niche. Such an extension of the room does not always occur, because the acoustic center is located within the hall itself; either since the addition of a sound niche is usually not practicable, the hall being not exclusively intended for the purpose of good hearing; or for the mode in which it is to be used, a simple platform or a speaker's desk is more appropriate.

252. Other Means for Good Effect of Tone.

For better effects of tones, the enclosing surfaces of the room are to be so formed and so limited, that useless dispersion of sound waves into empty space is prevented, and their reflections may have a beneficial effect. All space unsuitable or superflous for the purpose of hearing is injurious and is therefore to be omitted in designing the hall, since sound waves would be uselessly dispersed; material and form of the surfaces of the ceiling are to be so chosen, that they may be made useful to the effect of sound (vibrating surfaces placed near the source of sound), and that reflected sounds may be neutralized. For this reason, the most suitable form for lecture halls of moderate size is a quadrant, described from the position C of the speaker, instead of the more common form of hall enclosed by a semicircle; the omission of two circular sectors is therefore recommended, where seats are not desirable. Executed examples of both ground forms are given in Fig. 345. Yet in very large lecture halls, the angle at the center of the first ground form must be materially greater; the angles of the circular sector must also be cut off parallel to the middle axis.

If the preceding principles are decisive in fixing limitations of space for halls of moderate extent, they are much more so in halls intended for great numbers of persons, and which must therefore extend beyond the limits of distinct hearing. If the sound niche is omitted, then by other artificial means (reflector, sounding wall, sounding board) uniform diffusion with intensification of sound near its origin are to be produced. To prevent echos, the use of non-reflecting materials for the most distant parts of the room is to be recommended, as well as to avoid smooth surfaces, the arrangement of forms to disperse sound, recessing and rounding off angles of walls and

of ceiling, etc.

253. Requirements for Good Seeing.

The acoustic requirements of halls have so far been treated by themselves and even if these have not been exhausted here and must be [illegible] [illegible] requirements are not so [illegible]. [illegible] a [illegible] of the seeing [illegible] to the purpose. The demand for distinct seeing is in many cases to even precede that for distinct hearing. For many halls are intended only for the [illegible] [illegible]. If optical requirements have so far been [illegible], this is because they are more easily [illegible] than the [illegible] usually possible.

[illegible]

It is usually given at 85 ft. from the [illegible] there very [illegible] is necessary, as in school rooms. [illegible] small dimensions, [illegible] vision is not generally demanded by [illegible].

254. Diversity in Arrangement.

In many halls for music [illegible], as in churches, it is difficult [illegible] in each person with [illegible] the pulpit and the [illegible]. [illegible] Therefore these halls generally [illegible] with the front of the hall, [illegible] elevated, [illegible] at a greater distance.

In lecture halls, [illegible] the requirement of distinct vision is generally less important than that of distinct hearing. For a large [illegible] especially in halls for experiments, [illegible] In rooms of moderately [illegible] of the speaker is usually [illegible] than the [illegible]

of ceiling, etc.

253. Requirements for Good Seeing.

The acoustic requirements of halls have so far been treated by preference, and even if these have not been exhausted here and must be mentioned later, good acoustics is not alone decisive, but other requirements are now to be discussed. For in nearly all cases, a solution of the problem depends upon a happy combination of different properties required in a hall with reference to its purpose. The demand for distinct seeing is in many cases to even precede that for distinct hearing. For many halls are intended only for the enjoyment and perception of the eye, and not for those of the ear(hippodrome, circus, panorama, etc.). If optical requirements have so far been subordinated, this is because they are more simply satisfied than the acoustic, though both usually coincide.

The last is true with the limitation, that in a room where one sees well at all points, he generally hears equally well, though not always the reverse. For one may hear without seeing the source of sound, and with a suitable design of the room, the reflected sound rays also add to the better effect of the sound. To be able to see an object, no obstacle can exist between it and the eye of the observer; the visual aray must pass directly to the object. Even then optic requirements are more easily fulfilled than acoustic. The limit of distinct vision is more restricted than that of distinct hearing. It is usually given at 39.4 ft. from the object, or at 26.2 to 29.5 ft. where very clear vision is necessary, as in school rooms. Yet it is usually not required to restrict limits of space to small dimensions, since many exhibits are calculated for the use of opera glasses, and absolutely distinct vision is not generally demanded by others.

254. Diversity in Arrangement.

In many halls for public assemblies, as in churches, it is entirely sufficient if but a limited visual angle is open to each person with a possibility for him to conveniently see the pulpit and the speaker. The distance from the eye may then be considerable. Therefore these halls generally have a rectangular nave; hearers are distributed over the floor of the hall, and the speaker occupies a place more or less elevated, since he can thereby be visible and be more easily understood at a greater distance.

In lecture halls, legislative halls, etc.,the requirement of distinct vision is scarcely less important than that of distinct hearing. For a large room, darially arranged seats are indispensable, since the eye can then be directed exactly on the object; especially in halls for experiments, where the limiting distance cannot be made great. In rooms of moderate breadth and length, slightly curved or even straight seats are sufficient. The platform of the speaker is usually somewhat higher than the lowest of the usually as-

[illegible] rows of seats. [illegible] the object (speaker) must not be raised higher than the eye of the observer on the lowest row of seats.

In court rooms, the requirements of distinct vision and hearing vary for different parts of the hall, especially for the various persons engaged in the court proceedings and for the public. In theatres, the entire stage must easily be seen.

If these conditions primarily affect the internal arrangement of the hall, they likewise have great influence on the arrangement and form of the building. Just as in antique theatres, the arrangement of steeply inclined rows of seats in halls is a characteristic element of the structural organism, upon which depend not only the optic, but also acoustic properties of the room. [illegible] but is a curve, [illegible] horizontal and vertical distances of [illegible] the eye of the hearer or observer (Isacoustic Curve).

6. Arrangement in Detail.

In the preceding [illegible] the limitations of extent of space and the form of halls, although only in outline. But we will now contrast halls of Group I for good hearing and seeing (Fig. [illegible]) with halls of Group II [illegible] (Fig. [illegible]), and with Group III (Fig. [illegible]) [illegible] while briefly treating of other requirements of their design.

[illegible] Lighting.

The lighting of the hall is most intimately connected with the demands for distinct vision. So far as natural lighting is concerned, everything necessary has already been said [illegible] the lighting of [illegible] halls, [illegible] But in many halls natural light is less important than artificial, and the decorative subdivision of the ceiling depends on the arrangement of the lighting fixtures. [illegible] the arrangement and form of halls [illegible] only require to be suggested here.

[illegible] Proportions and dimensions.

As for the ratio of [illegible] width and length, [illegible] height in the room. [illegible] In general [illegible] height of the hall should not be too great, [illegible] Part [illegible], rule 2; very suitable for large halls).

cending rows of seats. But for very accurate vision, the object viewedmust not be raised higher than the eye of the observer on the lowest row of seats.

In court rooms, the requirements of distinct vision and hearing vary for different parts of the hall, especially for the various persons engaged in the court proceedings and for the public. In theatres,the entire stage must easily be seen.

If these conditions primarily affect the internal arrangement of the hall, they likewise have great influence on the arrangement and form of the building. Just as in antique theatres, the arrangement of steeply inclined rows of seats in halls is a characteristic element of the structural organism, upon which depend not only the optic, but also acoustic properties of the room. The inclination of rows of seats may not be on a straight line at pleasure, but in a curve, concave upwards, constructed to scale and in accordance with actual horizontal and vertical distances of acoustic or optic center from the eye of the hearer or observer (Isacoustic Curve).

2. Arrangement in Detail.

On the preceding principles are based the limitations of extent of space and the forms of halls, although only in outline. But we will now contrast halls of Group I for good hearing and seeing (Fig. 345) with halls of Group II for assemblies, festivals, exhibitions, etc. (Fig. 348), and with those of Group III (Fig. 347), which serve for all these purposes, and we will then compare them, while briefly treating of other requirements of their design.

255. Lighting.

The lighting of the hall is most intimately connected with the demands for distinct vision. So far as natural lighting is concerned, everything necessary has already been said in Art. 102; the lighting of museums, halls for collections and exhibitions, as well as that of courts of justice and of other halls, will be discussed in later volumes of this "Handbuch". But in many halls natural light is less important than artificial, and the decorative subdivision of the ceiling depends on the arrangement of the lighting fixtures. Some other factors influence the arrangement and form of halls and only require to be suggested here.

256. Proportions and Dimensions.

As for the ratio of height, width, and length, these have no less influence on the acoustic, than on esthetic effect of the room. From diversity in ground form, these relations can only be fixed in each case. It may be said in general that not only relative, but also to a certain degree, absolute dimensions are of importance. Height of the room should not be too great, since an echo might otherwise be produced (Art. 100, rule ?; very suitable for large halls).

Otherwise, by the construction of rows of seats one of galleries, as well as of niches and other excavations, the ground form of the room [illegible] much changed as its acoustic effect. In halls of Group 1 (Fig. [illegible]), [illegible] effect [illegible] of the [illegible] so that all seats [illegible] the [illegible], [illegible] is [illegible] the seats [illegible] [illegible] [illegible] each other. The height may be tolerably great if the ground surface is of moderate extent.

[illegible]. Designs of Halls.

Besides examples already mentioned and the [illegible] of buildings [illegible] [illegible] the [illegible] and hall of deputies in [illegible] of [illegible] [illegible] in [illegible], the following are characteristic typical forms; the [illegible] of one of the greatest theatre interiors, famous for its acoustic properties; the hall of the [illegible] in [illegible], [illegible] the [illegible] and Albert Hall in London, intended for eight thousand, or ten thousand with the [illegible] [illegible] [illegible] in acoustic [illegible], [illegible] [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] with [illegible] [illegible] [illegible] where one is [illegible] [illegible] [illegible] [illegible] arrangement of seats.

The [illegible] hall (Fig. [illegible]) has the proportions of about 2 : 4 : 6 and is [illegible] lighted from the ceiling. The [illegible] area of about [illegible] [illegible] [illegible], but the considerable height of about [illegible] ft. would produce very disturbing effects of sound, were it not that the [illegible] ceiling is [illegible] of [illegible] form and of solid materials (Fig. [illegible]). [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] effect of the [illegible] by the [illegible] [illegible] [illegible] completely [illegible]. These [illegible] are not [illegible] [illegible] the [illegible] hall of the [illegible], although [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. The [illegible] of the [illegible] [illegible] (Fig. [illegible]) only at its ends [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of height, breadth and length are 2 : 4 : [illegible].

In halls of [illegible], [illegible] especially in [illegible] of [illegible], and which must be [illegible] to [illegible] of the most diverse kinds, the ground form is generally that of a [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] terminating in a circular [illegible], [illegible]. These forms are designed to carry the sound further in the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

Otherwise, by the construction of rows of seats and of galleries, as well as by niches and other extensions, the ground form of the room is as much changed as its acoustic effect. In halls of Group I, Fig. 345, formed after the model of the antique theatre, so that all sound may pass radially and directly to the ear, the seats are generally stepped, being partly in rows above each other. The height may be tolerably great if the ground surface is of moderate extent.

257. Designs of halls.

Besides examples already mentioned, and the lecture hall of Midland & Birmingham Institute and Hall of Deputies in Palace of Legislative Assembly in Vienna, the following are characteristic typical forms; the Scala in Milan, one of the grandest theatre interiors, famous for its accoustic properties, hall of the Trocadero Palace in Paris, which holds about five thousand persons, and Albert Hall in London, intended for eight thousand, or ten thousand with the highest gallery. Even if defective in acoustic relations, when compared to halls of oblong ground plan, they prove it possible to build halls of this type on the principle of direct radiation of rays, which can contain twice as many persons as a rectangular room, where one is partially compelled to rely upon indirect transmission of sound.

The Albert Hall (fig. 345) has the proportions of about 3 : 4 : 5 and is entirely lighted from the ceiling. The concave glass area of about 138 ft. by 174 ft. and the considerable height of about 131 ft. would produce very disturbing effects of sound, were it not that the velarium (awning) is made in convex form and of solid materials (Fig.348). To this arrangement and also to wooden wainscoting of enclosing walls of orchestra and galleries is chiefly to be ascribed the satisfactory effect of tone found in the building, both when moderately,or completely filled. These properties are not possessed equally by the festal hall of the Trocadero, although considerably smaller, unless Garnier's expression has become true since it was opened (1878), " that halls eventually become like wine in bottles". The large hall of the new Cloth Hall in Leipzig (Fig. 345) only at its ends extends beyond Arth's limit of distinct hearing. By its form it belongs to the examples in Fig. 348;the proportions of height, breadth and length are 3 : 4 : 8.

In halls of unusual size, especially in those of Group III, and which must be adapted to purposes of the most diverse kinds, the ground form is generally that of a rectangle. Their form is much changed by cutting off or rounding the corners, the ends frequently terminating in circular arcs, etc. These forms are designed to carry the sound further in its initial direction, and the width is accordingly almost always considerably less than the length. This is seldom less than 1 1/2 times the width; the ratio of approximately 2 to 1

same frequently occurs, and even that of 2 to 1 is sometimes reached (Fig. [illegible]), and the height cannot be very great. [illegible] be the danger of disturbing echoes of sound. The space of "[illegible] [illegible]" [illegible] [illegible] [illegible] [illegible] [illegible] may be [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] be extended.

These plane halls not only serve for oratorical, musical, and theatrical uses, but also for festal assemblies and for other purposes requiring the floor area of the room, the floor of the hall is [illegible] [illegible]. [illegible] [illegible] are usually arranged along the walls, as well as projecting balconies, [illegible] [illegible] [illegible], and the latter are either [illegible] [illegible], as in the [illegible] [illegible] [illegible] [illegible] [illegible] (Fig. [illegible]) [illegible] to the ceiling of the hall. The latter arrangement frequently occurs with a division into three aisles, and sometimes with one in five aisles [illegible] [illegible] [illegible] [illegible] Central [illegible] of Alexandra Palace in London, Fig. [illegible])

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] hall, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] into platforms and [illegible] for spectators and [illegible]. The lower parts of the [illegible] [illegible] serve for [illegible] [illegible] [illegible] [illegible] [illegible] hall, as in the [illegible] hall in [illegible] (Fig. [illegible]); the [illegible] [illegible] is sometimes omitted above and there is only the [illegible] [illegible], as in the [illegible] of bourse in Vienna (Fig. [illegible]). Smaller halls of this kind [illegible] [illegible] [illegible] [illegible] [illegible], or only one at one end. [illegible] [illegible] [illegible] [illegible], is the [illegible] garden of [illegible] [illegible] in [illegible] (Fig. [illegible]); [illegible] at [illegible] is much [illegible].

A peculiar form is shown by the concert and festival hall of [illegible] [illegible] (Figs. [illegible], [illegible]) but which certainly cannot accord with the requirements of acoustics; at least its arrangement and form [illegible] [illegible], as well as [illegible] [illegible] of the [illegible] [illegible], permit us to assume the nature of the [illegible] [illegible] [illegible] [illegible], etc. In a few cases, the sound niche, if used, is placed at the center of the longer side, but it is otherwise always arranged at the [illegible] end. In the design of halls [illegible] [illegible] intended for [illegible] [illegible], [illegible], exhibitions, etc., one is naturally less restricted, and Fig. [illegible] [illegible] [illegible] [illegible] forms of [illegible] [illegible] occur; the choice is [illegible] of [illegible] [illegible] partly determined by local conditions, and by the requirements of the [illegible].

As an example of a simple [illegible] building, the [illegible] of [illegible]

more frequently occurs, and even that of 3 to 1 is sometimes reached (Fig. 347). But the height cannot be very great. The lower the hall, the less will be the danger of disturbing effects of sound. The ratio of "height equal to width(measured between enclosing surfaces)" appears to be the limit, which can be reached only in halls of moderate or small absolute dimensions, and can scarcely be exceeded.

Since these halls not only serve for oratorical, musical, and theatrical uses, but also for festal assemblies and for other purposes requiring the free use of the room, the floor of the hall is made horizontal. Yet platforms are usually arranged along the walls, as well as projecting balconies, rows of seats, or galleries, and the latter are either built free, as in the large hall of the Building of the Musik Verein in Vienna (Fig. 349), or they extend to the ceiling of the hall. The latter arrangement frequently occurs with a division into three aisles, and sometimes with one in five aisles (Festival Hall in Carlsruhe; Central Hall of Alexandra Palace in London, Fig. 347) This is substantially the basilican form of hall, where side aisles are in height chiefly divided into platforms and galleries for spectators and auditors. The lower parts of the aisles sometimes serve for communication and lie outside the main hall, as in the City Hall in Mayence (Fig. 350); the gallery is sometimes omitted above and there is only the lower passage, as in the hall of Bourse in Vienna (Fig. 353). Smaller halls of this kind mostly have neither passages nor galleries, or only one at one end. Such an example of important extent, is the winter garden of Central Hotel in Berlin (Fig. 347); proportions being about 3:14:13. Among German designs of halls, this one covers the greatest clear floor area without intermediate supports, even though the Clear span of City Hall at Maintz is much greater.

A peculiar form is shown by the concert and festival hall of Casino at Ostend (Figs. 351, 347) but which certainly cannot accord with the requirements of acoustics; at least its arrangement and form in general, as well as location of the sound niche, permit us to assume the nature of the glazed enclosing surfaces, etc. In a few cases, the sound niche, (if used) is placed at the center of the longer side, but it is otherwise always arranged at the rear end. In the designs of halls in Group II intended for assemblies, festivals, exhibitions, etc., one is naturally less restricted, and Fig. 348 shows that all typical forms of halls indeed occur; the choice is partly at pleasure and partly determined by local conditions, and by the requirements of the problem.

As an example of a simple elongated building, the hall of Palazzo della Ragione in Padua may serve, one of the largest halls in Italy, with approximate proportions of 1 : 1 : 3. The new Vienna Bourse is a basilican structure of very noble dimensions with proportions of about 4.5 : 5 : 11. The Glass Pal-

ace in Münich, used as a hall of the largest size for the past ten years, is five-aisled and arranged in cross-form. The same form appears in the relatively very small hall of Hotel Frankfurter Hof at Frankfort-o-M. The festal hall of City Hall in Berlin again has the rectangular form with a single gallery along the longer side, and proportions of about 1 : 1 : 2. A circular building of vast dimensions, the largest clear internal area now existing, is found in the rotunda of Vienna Exposition of 1873; it properly received a relatively low height with a ceiling of conical form. Another circular design of very imposing diameter is the reading hall of the British Museum in London, not intended for acoustic effects and covered by a great dome. The same is true of the small though beautiful rotunda of Old Museum in Berlin (Fig. 352). A notable example of a tetrastylar design with elliptical niches occurs in the reading hall of National Library in Paris (Fig. 356).

258. Dimensions.

Figs. 345 to 347 give dimensions of several halls of various kinds, No acoustic or optic center exists in those of Group II, and therefore the magnitude of the room is not limited in that respect; but it is frequently so in reference to construction, lighting and other points. Dimensions are generally fixed in accordance with the number of persons expected in the room and area required by each person, whether greater or smaller, according to the mode of use. Data on this point will be given later, when this point can be more fully discussed with the different kinds of buildings.

259. Form of Ceiling; Treatment of Forms.

Everything necessary has already been said in regard to form of the ceiling in reference to acoustics, and in reference to construction and treatment of forms in Art.98, 160 to 165, and 171 to 186. Besides examples there given, forms of cross sections of some halls are represented in Figs. 348 to 351, with internal views in Figs. 352 to 357. The latter illustrate the treatment of the forms, with reference to Arts. 167 to 170.

The great hall of Vecchio Palace in Florence (Fig. 354) is a remarkable Italian example with horizontal ceiling, and the hall of Middle Temple in London (Fig.355) is a similar one of the Elizabethean era with a visible decorated framework of roof. As forms of halls of the modern period are the already mentioned domed rotunda of Old Museum in Berlin (Fig.352), with a free colonnade and aisle around it, and the reading room of National Library in Paris (Fig. 356), which may be assumed as typical; the visible iron construction of the ceiling supports nine domical vaults, covered by colored tiles. The section of the hall of Bourse in Vienna (Fig. 353) shows an intersecting groined ceiling with a large horizontal middle panel; the hall of building of Musik Verein in Vienna (Fig. 349) has a horizontal ceiling, City Hall in Mayence

(Fig. 350) has a ceiling of segmental arched form with visible iron construction, and Albert Hall in London (Fig. 348) has a domed ceiling. The cross section of Concert hall in Ostend (Fig. 351) recalls Byzantine centralized buildings. A remarkable example of a large hall with galleries and entirely constructed of iron is given in the main hall of Museum of Natural History in Paris (Fig. 357).

280. Location.

A few words remain in regard to location to be assigned to the hall in the building in which it belongs; for one commences with this in designing it according to the principles already developed. The question whether the hall shall be located in a ground or upper story will usually be settled by the requirements of the programme. This decision indeed fixes the entire architectural organism of the work.

Not less important is fixing its location on the plan. The hall is such an important motive for external appearance of the building, that in all cases a prominent position must be assigned to it in the plan. Particularly in monumental buildings it will almost always be best to place it on the main axis, and frequently on the transverse axis of the building also, as in centralized buildings. Yet requirements of suitability and accessibility must not be neglected. (For relation of main entrance and main stairway to that of hall, see Arts. 128 to 215).

We will close this investigation by repeating the last words of Art. 179:- "The highest effect in decoration and the most harmonious lighting should be produced in the chief apartments of the building. In it should be expressed in monumental designs the intellectual significance of the building, in which the form of room, decoration, sculpture, and painting may work together in a harmonious way."